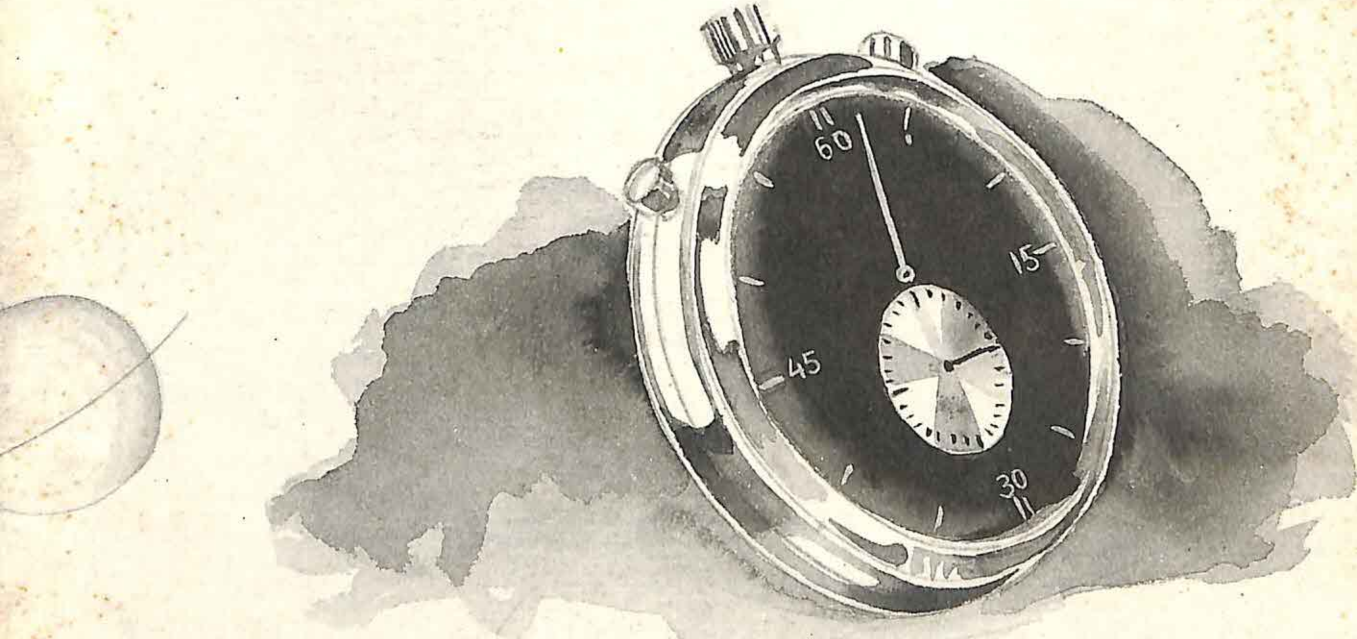
NEW MATRICULATION
PHYSICS



6

NEW MATRICULATION
PHYSICS 6

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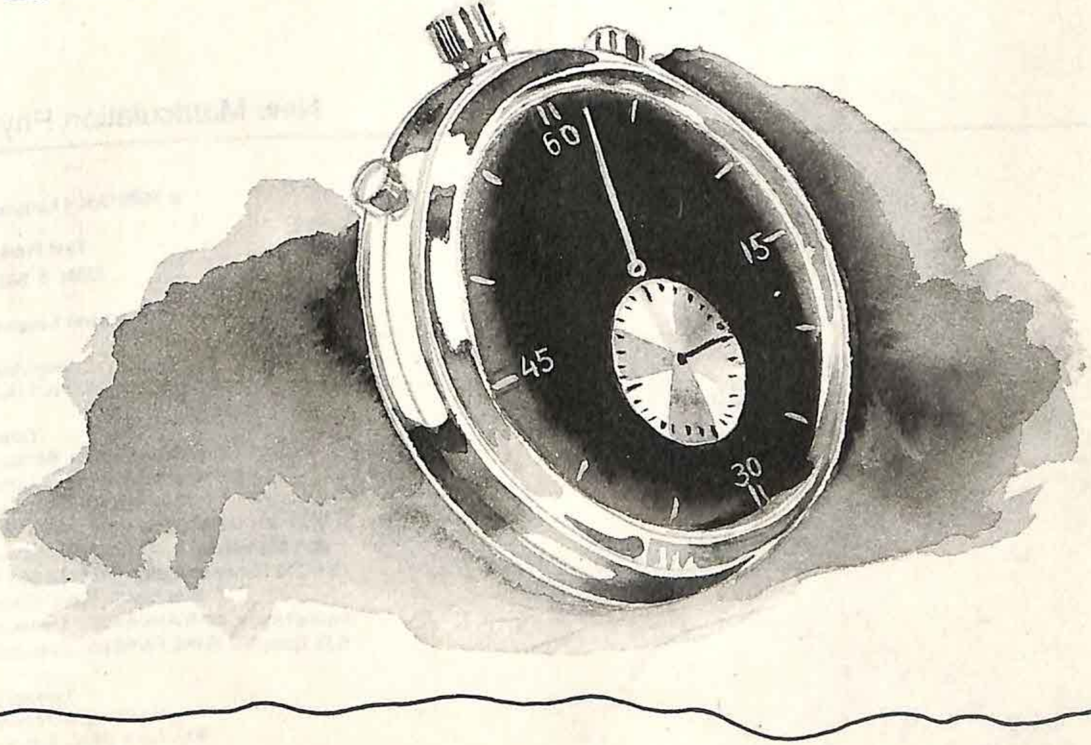

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To the teacher

New Matriculation Botany is a series of five books developed for class 6-10 of the Tamil Nadu Matriculation system. It closely follows the new enriched Matriculation syllabus.

One of the main features of the new syllabus is that activity and observation are given a very important place in understanding science. Every effort has been made to unfold the scope and purpose of the syllabus. This series departs from the conventional and emphasises a practical, 'discovery' and 'learning by doing' approach.

The subject matter to be studied has been carefully arranged keeping in mind the age level and psychology of the child. No effort has been spared to support the text with clear, labelled illustrations. The language has been kept simple and direct to enable the students to read the text themselves.

Several activities and projects have been suggested, wherever possible, within the scope of the lesson. Most of these need simple improvising or inexpensive materials.

The exercises for each chapter are exhaustive and include questions based on comprehension and application of basic principles rather than on mere recall.

It has been the concern of the authors that children are encouraged to discover for themselves the pleasure of learning about the fascinating 'laws of nature'.

The author

MATRICULATION SYLLABUS FOR STANDARD VI – PHYSICS

	Concept/theme	*Expected Outcome Of Learning*	*Teaching / Learning Activities*
1.	**Measurement**		
1.1	Fundamental units	Realises what the fundamental units are, and why the metric system is preferred.	Experiments with commonly used means for measuring length, mass and time.
1.2	Length	Measures given lines adopting different methods.	Measuring straight and curved lines by various methods.
1.3	Area	Measures and calculates areas of regular figures.	Measuring and calculating areas of regular figures.
1.4	Volume	Estimates volumes.	Experiments to get the volumes of regular / irregular solids and to measure volumes of liquids.
1.5	Mass	Distinguishes between mass and weight	Devises a simple beam balance and a set of weights for rough estimation of mass.
1.6	Time	Appreciates the progress in the devices for measuring time.	Makes models of sun-dial, water and sand clock, and pendulum.
2.	**Mechanics**		
2.1	Idea of motion and of rest	Distinguishes the type of motion.	Lists out examples for each type of motion from everyday life around.
2.2	Force–types and effects.	Appreciates the need of force for motion to occur	Identifies different types of forces resulting in motion. Observe the effects of force.
2.3	Measurement of a force	Realises that weight is a force due to gravity, its dependence on force and units of work.	Constructs and uses a spring and compression balance.
2.4	Work		Understands the concept of work when referred to in Physics.
2.5	Energy		Lists the types of energy the child is familiar with
2.6	Machines	Appreciates the ways in which machines are useful.	Observes the three systems of levers, and identifies the load, effort and fulcrum. Collects, uses, draws and classifies simple tools used daily into the three orders. Recognises the pulley and inclined plane as simple machines.
3.	**Hydrostatics**		
3.1	Density	Appreciates the concept by an analogy to population.	Weighs equal blocks of different materials with balance constructed and explains the difference. Calculates density, given mass and volume of an object. Learns to determine volume or mass given the other two quantities.

	Concept/theme	Expected Outcome Of Learning	Teaching / Learning Activities
3.2	Thrust and pressure	Differentiates between thrust and pressure	Observes how pressure is reduced by increasing area of base. Special reference to heavy animals and their feet; tools for piercing and cutting.
3.3	Liquid pressure	Recognises the properties of liquids	Experiments to study the various aspects of liquid pressure. Observes the principle behind the water supply system both in a home and in the town.
3.4	Floating	Appreciates the reason for objects floating on a medium.	Experiments to find out what objects, and what type of shapes can float in water. Observes the loading line for ships.
3.5	Atmosphere	Infers that air also has weight and exerts pressure.	Experiments with simple devices like straw, ink filler and syringe which make use of air pressure. Construct a home made spirit level and water fountain.
4.	**Heat**		
4.1	Sources of heat		Lists out the commonly used sources.
4.2	Effects	Recognises expansion and contraction	Experiments to see solids, liquids and air expand on heating. expand on heating.
	Changes in dimension		Observes how the effects of expansion are taken care of in hot water pipes, railway tracks, bridges, etc.
	Change of state	Infers that evaporation and condensation are taking place continually.	Observes how rain is caused. Appreciates the water cycle, by starting from ice and heating and then by cooling
	Change of temperature		Use of thermometer.
	Change in chemical and biological properties		Observes and understands the cause for fermentation curdling of milk, hibernation of animals, change in seasons. Lists uses of heat at home, in industry, in vehicles, etc.
4.3	Uses	Recognises the uses of heat in life situations.	Realises the hazards of fire and simple means of control.
5.	**Light**		
5.1	Sources	Distinguishes between natural and artificial sources	Lists out common natural and artificial sources Distinguishes between luminous and non-luminous objects.
5.2	Optical media	Discriminates between different types of media.	Lists out and finds the difference between opaque, transparent and translucent media.
5.3	Path of light	Infers that light travels in straight lines in all directions from source.	Does simple experiments to study the path of light, and realises when and how shadows are formed.

	Concept/theme	Expected Outcome Of Learning	Teaching / Learning Activities
			Studies the shadow difference using a point / extended source.
5.4	Colours in white light	Infers that white is a combination of seven colours.	Demonstrates the breaking up of white light using a prism or a mirror and water.
5.5	Uses	Recognises the several uses of light.	Lists out the common uses, and find out about some modern uses like lasers.
6.	**Sound**		
6.1	Making Sound	Recognises the variety of sounds existing around us.	Lists out the various ways of making a sound, and classifies them into four distinct groups.
6.2	Types	Recognises the types of vibrations involved.	Experiments to make loud and soft sounds; high and low sounds.
6.3	Speed of sound	Infers that the velocity of sound is much slower than light.	Lists out examples to prove that sound travels slower than light.
6.4	Uses	Recognises the uses of sound in daily life	Lists / draws to show uses of sound. Finds out animals produce sounds.
7.	**Magnetism**		
7.1	Natural and artificial magnets	Recognises the different shapes of magnets.	Observes magnetic and non-magnetic substances with respect to their behaviour with a magnet. Classifies objects according to material as magnetic or non-magnetic.
7.2	Magnetic force	Recognises magnetic force is felt at a distance and through certain materials.	Experiments with a magnet to feel its force through paper, water etc.
8.	**Electricity**		
8.1	Uses	Appreciates the wide variety of uses of electricity today.	Lists out how electricity is used in each instance recognising the changes of electrical into other forms of energy.
8.2	Electric cell, circuit	Recognises part of an electric cell, sees relationship between the components of an electric circuit.	Opens out and examines a dry cell. Learns to make a simple circuit.
8.3	Conductors and non-conductors	Distinguishes between conductors and non-conductors.	Experiments to find out what materials allow flow of electric charge, and what don't.
8.4	Heating and lighting effect of current.	Recognises the use of conversion of electrical energy into heat and light in commonly used gadgets at home.	Observes heating and lighting effect in gadgets like toaster, iron, geyser, hot plate or immersion rod.

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1. Measurement

Fundamental Units - system of units - length - methods of measuring length - area - methods of measuring area - volume - methods of measuring volume - mass - weight - time - progress in devices to measure time

Physics is the science of accurate measurement. In our day to day life, we come across many quantities that we need to measure. When you buy cloth, or when you go to the market to buy vegetables or food grain, you will find that everything is 'measured' and sold.

If we say we bought a lot of cloth or a large quantity of rice, no one will really have an idea of how much we bought. But if we say that we bought 5 metres of cloth or 10 kilograms of rice then the statement has some meaning. You will notice that we use the words 'metres' and 'kilograms' to measure the length of the cloth or the amount of rice. This simply means that the length of the cloth is five times the length of a standard length called the *metre*, or the mass of rice is 10 times the mass of a standard mass called the *kilogram.* These standards are called the '*units*' of the quantities measured. In science, of course, our measurements need to be even more accurate than those in the market.

Activity 1 : *Make a list of at least five different types of measurements you come across every day. For example, the amount of milk in a bottle or sachet, or the speed of a car.*

1.1 Fundamental units

You will notice that most of the quantities we measure, are in terms of the units of length, mass and time. These units are independent of each other and are called *fundamental units.*

The units of quantities which are based on the fundamental units are called *derived units*. For example, the unit of area depends on the unit of length. The unit of speed depends on the units of length and time. Can you name any quantity whose unit depends on other fundamental units?

SYSTEM OF UNITS

In earlier times, different countries used different standards as their units. For example, the British used the 'foot' to measure length and the French used the 'centimetre'. On 14 October 1960 the 'International Conference of Weights and Measures' was held in Paris. Scientists from all over the world agreed on a new system of units called the *International System of Units (SI System of units)*. The metric system (MKS) is part of this system.

In the metric system, the fundamental units of length, mass and time are measured in metres, kilograms and seconds. Hence the name MKS.

Activity 2 : *Measure the length of your text book, first with one edge of your ruler and then with the other edge. Write down the length and the units with which you measure using each edge of the ruler. Which do you think is more accurate?*

Actually, the length you measured in inches is as accurate as the length you measured in centimetres, but you would have found it easier to write the correct value in centimetres. A centimetre is part of the metric system and it is $\frac{1}{100}$ th part of a metre.

The metric system has been chosen as an International system because it is a decimal system. In this system any unit is 10 times more or less than the next unit. There is also a simple relation between units of length, mass and volume in the metric system, e.g., 1 litre is 1000 cc, 1 litre of water weighs 1 kg, etc. Hence it is easier to measure with and do calculations in this system than any other system.

Activity 3 : *Watch your mother buying vegetables from a vendor Note down the following :*
(a) In which pan are the vegetables placed?
(b) What system of units does the vendor use?
(c) What does he put in first, the vegetables or the weights?
(d) When is the weighing complete?

Activity 4 : *Make a list of the different types of watches worn by children in your class. How are they different from each other?*

1.2 Length

Length can be defined as the *linear or curved distance between two points*. Even though the unit of length in the SI system is the metre, it is not always convenient to measure length in metres. Sometimes, we need to measure length in multiples or sub-multiples (smaller multiples) of the metre. If we want to measure very large distances such as the distance between, say Bombay and Delhi, we use the kilometre which is 1000 metres. If the length of a classroom is to be measured then we could measure it in metres because our classroom is not as large as the distance between two cities. If we want to measure the length of a book, or a line drawn on a paper, we use sub-multiples of the metre such as centimetre = (1 / 100 metre) or millimetre = (1 / 1000 of a metre).

Hence we have,

Multiples of a metre (m)

1 decametre (dam) = 10 m

1 hectometre (hm) = 100 m

1 kilometre (km) = 1000 m

Sub-multiples of a metre (m)

1 decimetre $= \frac{1}{10}$ m

1 centimetre $= \frac{1}{100}$ m

1 millimetre $= \frac{1}{1000}$ m

Activity 5 : *Learn the above multiples and sub-multiples and then fill in the blanks below.*
1/10 th of a metre is the _ _ _ _ _ _ _.
1/100 th of a metre is the _ _ _ _ _ _ _.
1/1000 th of a metre is the _ _ _ _ _ _ _.
One kilometre equals_ _ _ _ _ _ _ _ metres.

MEASUREMENT OF A STRAIGHT LINE

A straight line is usually measured using the centimetre scale as is found in the ordinary school ruler. In measuring a given length the following points have to be noted :

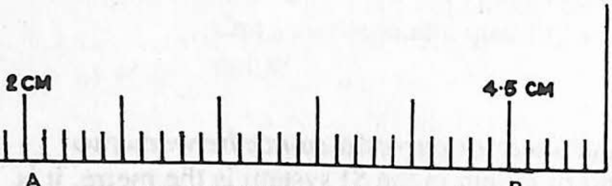


Fig. 1.1 Using a scale accurately

1. The ends of the ruler are usually worn out due to frequent use and so we should start our measurement from some other division, and find the reading corresponding to the other end of the length being measured. The difference between the two readings gives the length of the line (Fig. 1.1).

Length of the line
AB = 4.5 − 2 = 2.5cm.

2. While measuring the length of an object, the readings should be taken directly from above. If this is not done, the reading may be slightly more or less than the correct reading. This is called a parallax error, as shown in Fig.1.2.

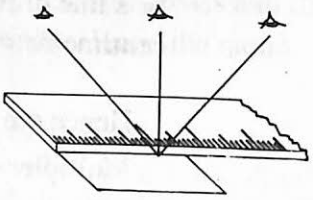


Fig. 1.2 Parallax error

This error can be avoided by placing the ruler on its edge, as in Fig.1.3, and then taking the measurement. By doing this, the scale divisions are actually in contact with the line being measured, and so an exact reading can be obtained.

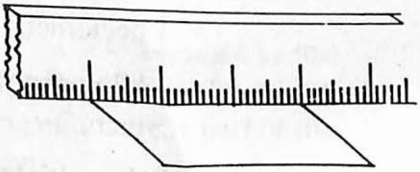


Fig. 1.3 Avoiding parallax error

Activity 6 : *Measure these lines and write their lengths beneath them. Compare your values with that of your neighbour's. Is there a difference in length when the ruler is placed on its edge?*

MEASUREMENT OF LENGTH OF CURVED LINES

1. *Thread method* : A curved line can be measured using a sewing-thread (Fig.1.4). Tie a knot at one end of a piece of thread and place the knot at the beginning of the curve to be measured. Hold the knot firmly in position with a finger of your left hand. Now

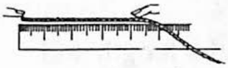


Fig. 1.4 Measuring a curved line – thread method

slowly trace the thread along a small part of the curve using a finger of your right hand then hold your right hand firmly on the thread and move the finger of your left hand upto the finger of your right hand. Continue this procedure until you reach the end of the line. Make a mark on the point of the thread which exactly coincides with the end of the curve. Measure the length of the thread you have used, i.e., from the knot to the mark, by means of a millimetre scale. This gives you the accurate length of the curve.

2. *Divider method* : A curved line can be divided into a number of short equal lengths, each of which can be taken to be a straight line. Take a divider or a compass and divide the given curved line into short equal lengths AB, BC, CD, etc. (Fig.1.5a). Measure the length of one short line by placing the points of the divider on a scale (Fig.1.5b). Multiply the length so obtained by the number of equal lengths. If there is a remainder add this to the final reading. This gives the length of the curved line.

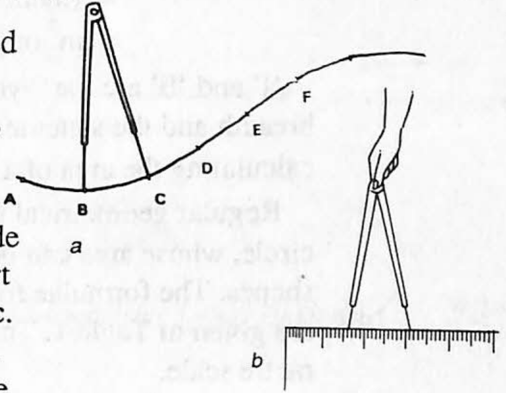
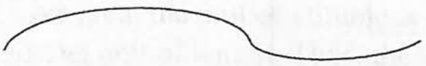
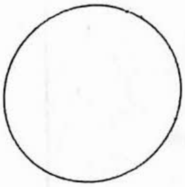


Fig. 1.5 Measuring curved lines – divider method



Activity 7 : *1. Measure the length of this line using the thread method. Compare your answer with that of your partner's.*
length = _ _ _ _ _ _ _ _ _ _



2. Measure the circumference of this circle using the divider method.
The circumference of the circle = _ _ _ _ _ _ _ _ _ _
Verify your answer by using the thread method.

1.3 Area

A desk may have a smaller surface area than a table. Similarly, a cricket ball has a smaller surface than a foot ball.

The extent of the surface of a body is called its area. In order to find the area of a body two lengths are to be measured (Fig.1.6). Hence the

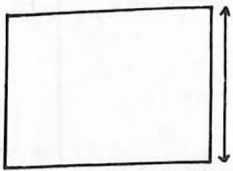


Fig. 1.6 Measuring area

unit of area will be

$$\text{metre} \times \text{metre} = m^2 \text{ or sq.m.}$$

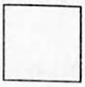
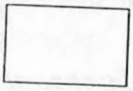
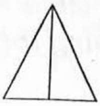
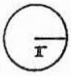
Thus, to measure the area of a rectangle we measure the length and breadth and calculate the area from our knowledge that

$$\begin{aligned} \text{area} &= \text{length} \times \text{breadth} \\ &= l \times b \\ &= \text{metres} \times \text{metres} \\ &= (\text{metre})^2 \\ &= m^2 \text{ or sq.m.} \end{aligned}$$

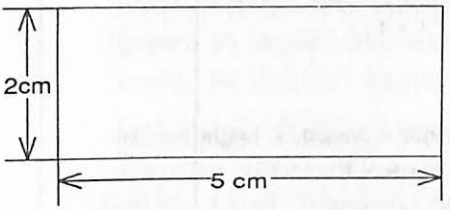
'l' and 'b' are the 'symbols' used here to denote the length and breadth and the statement, area = length × breadth is the formula for calculating the area of a rectangle.

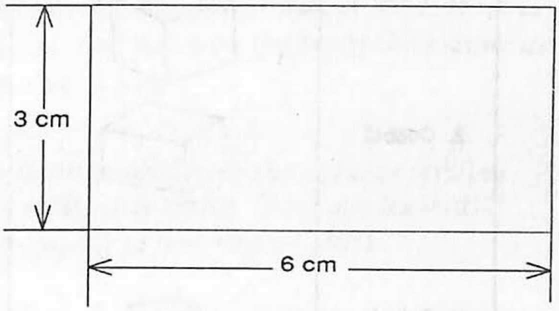
Regular geometrical figures such as square, rectangle, triangle and circle, whose area can be calculated from a formula are called regular shapes. The formulae for calculating the area of some regular shapes are given in Table 1. The various dimensions can be measured using a metre scale.

TABLE 1

Shape	*Figure*	*Area*	*Formulae* Sq.m.or $\backslash m^2$
Square		$l \times l$	l^2
Rectangle		$l \times b$	lb
Triangle		$\frac{1}{2}$ base × height $\frac{1}{2} b \times h$	$\frac{1}{2} bh$
Circle		$\pi \times (\text{radius})^2$ where $\pi = \frac{22}{7}$	πr^2

Activity 8 : *Here are two rectangles A and B. Which of them has a larger area? How do you know this? Write the value of the areas of both the rectangles.*





Area of rectangle A = ___________sq.cm.
Area of rectangle B = ___________sq.cm.

Activity 9 : *Measure the length and breadth of your desk and calculate its area.*

1.4 Volume

If you look around your classroom, you will notice that everything in it, i.e., the tables, chairs, desks, books, etc., occupy space. *The space occupied by a body is called its volume.*

Like area, the unit of volume is derived from the unit of length. Thus, the volume of a cuboid can be measured by measuring three lengths (Fig.1.7).

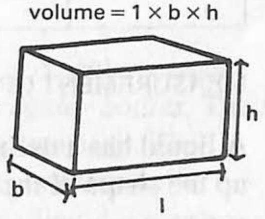


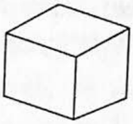
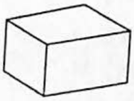
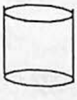
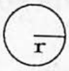
Fig. 1.7 Measuring volume

Volume = length × breadth × height
= l × b × h
lbh
= metres × metres × metres
= $(\text{metre})^3$ or cubic metres

This is written as m^3 or cu.m.

The volume of regular bodies can be calculated from their dimensions with the help of the formulae given in Table 2. If the lengths are measured in centimetres then the volume obtained is in cubic centimetres (cc).

TABLE 2

Shape	Figure	Volume	Formula m^3
1. Cube		length × length × length $l \times l \times l$	l^3
2. Cuboid		length × breadth × height $= l \times b \times h$	lbh
3. Cylinder		$\pi \times (\text{radius})^2 \times \text{height}$ $\pi \times (r)^2 \times h$	$\pi r^2 h$
4. Solid cone		$\frac{1}{3} \times \pi \times (\text{radius})^2 \times \text{height}$ $\frac{1}{3} \times \pi \times r^2 \times h$	$\frac{1}{3}\pi r^2 h$
5. Sphere		$\frac{4}{3} \times \pi \times (\text{radius})^3$ $\frac{4}{3} \times \pi \times r^3$	$\frac{4}{3} \times \pi \times r^3$

MEASUREMENT OF THE VOLUME OF LIQUIDS USING A MEASURING JAR

A liquid has a definite volume but no definite shape of its own. It takes up the shape of the vessel in which it is poured.

The measuring jar (Fig.1.8) is a tall glass jar with a spout at its upper end to help while pouring liquids. A scale in cubic centimetres is marked along the length of the jar. The numbers of the scale in cubic centimetres is marked along the length of the jar. The numbers of the scale read upwards.

When the jar is filled with a liquid, the scale division on the body of the jar shows how

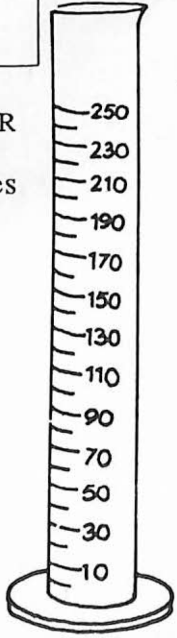


Fig. 1.8 The measuring jar

many cubic centimetres of liquid are contained in it.

A liquid in a hollow tube has a curved surface called a meniscus (Fig.1.9). Therefore care must be taken to measure it accurately. While measuring, the eye must be in line with the lowest part of the meniscus formed by liquids like water (Fig.1.9a) and with the tip of the meniscus formed by liquids like mercury (Fig.1.9b).

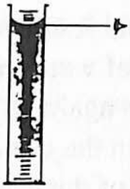


Fig. 1.9 a Water meniscus

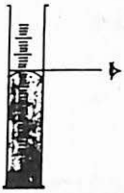


Fig. 1.9 b Mercury meniscus

Activity 10 *: To do at home :*
Find an old medicine bottle (empty) and note the volume written on the label. Wash the bottle well with water. Now use the bottle as a measure to find out the volume of any cup or glass.

Activity 11 : *Bring empty containers or boxes of a regular shape to class. For example an empty shoe box (cuboid), an empty plastic container or powder tin (cylinder), a cardboard box which is cubical in shape, a rubber ball (sphere). Now using Table 2., find the volume of each container.*

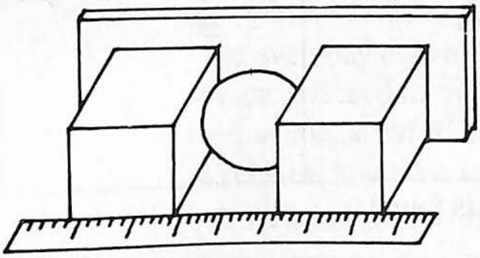


Fig. 1.10 Measuring the diameter of a cylinder

Note : The diameter of the cylinder and sphere can be measured by placing the sphere between two blocks of wood and reading the distance between the two blocks on a scale as shown in figure 1.10.

VOLUME OF IRREGULAR BODIES

If you examine a stone you will notice that it has no regular shape. Bodies which have no regular shape are called *irregular bodies*. Their volume cannot be measured by measuring their dimensions. The volume of irregular solids can be measured using a measuring jar or overflow jar. If a solid is completely immersed in a liquid it displaces a volume of liquid equal to its own volume. We make use of this fact when using the measuring jar and overflow jar.

MEASURING JAR

Procedure : Clean a measuring jar and pour a suitable quantity of water into it. The volume of water poured should be enough to completely immerse the solid. Note the position of the level of the meniscus - A (Fig. 1.11a).

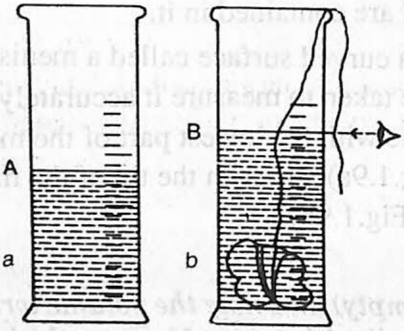


Fig. 1.11 a Level of water in jar

Fig. 1.11 b Rise in level of water

Tie the given solid to a thread and immerse it into the water in the jar. The level of water rises. Now note the level of the meniscus again (B) (Fig.1.11b). The difference between the volume of the two levels gives the volume of the given solid.

Change the level of water and repeat the experiment several times.

Tabulate the readings as follows :

TABLE 3

No	First level of water cc.	Level of water after . immersing solid cc	Difference. = volume of solid cc
1.	60	85	25
2.			
3.			
4.			
5.			

The average volume of the solid is found.

OVERFLOW JAR

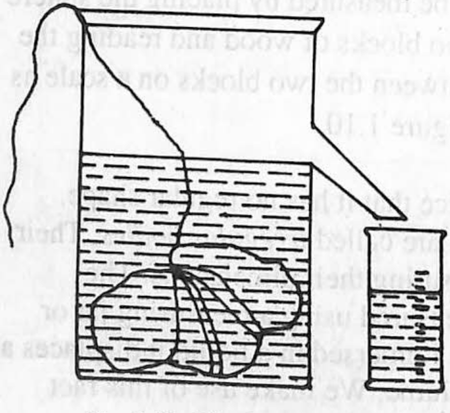


Fig. 1.12 The Eureka can

For objects which are too large to be placed in the measuring cylinder, a metal or glass can with an overflow pipe, (the Eureka can) may be used. Water is poured into the jar until it begins to flow out of the pipe. After drops have stopped falling from the pipe, an empty measuring cylinder is placed beneath the spout. The solid whose volume is required is then gently lowered into the jar by means of a thread. Since the solid will displace its own volume of water, the volume which overflows into the measuring cylinder is the volume of the solid.

Activity 12 : *Group work :*

Things needed (for each group) : a measuring jar, a piece of string, some water and an irregular shaped object such as a stone. Using the measuring jar method described above, find the volume of the stone.

1.5 Mass

Activity 13 : *Collect a few stones of different sizes. Which is the heaviest? Which is the lightest? Can you roughly estimate the mass of each?*

All bodies have a mass, which *is the amount of matter it contains*.The mass of a body is a constant quantity. A cubic metre of iron contains the same amount of matter whether it is on the earth or on the moon. The unit of mass in the SI system is the kilogram.

WEIGHT

The weight of body is the force it exerts on anything that supports it. This force is, normally, exerted because the body itself is attracted towards the earth by the *force of gravity*.

In everyday conversation we show no distinction between mass and weight and tend to use one term for the other. A vegetable vendor, in fact, would be surprised if you asked him what is the 'mass' of brinjals. In science, however, we have to be careful to distinguish between them.

This is because while the mass of a body remains constant, its weight might change according to the place where it is being measured, i.e., according to the pull of gravity on it.

It is interesting to note that a body weighs more at the poles and less at the equator. Can you think of why this is so?

UNIT OF MASS

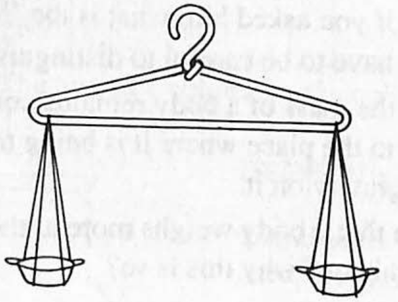
The unit of mass in the metric system is the kilogram. Sometimes we need to weigh very heavy objects especially in factories. We then use multiples of the kilogram. At other times we need to weigh much lighter objects and so we use sub-multiples of the kilogram.

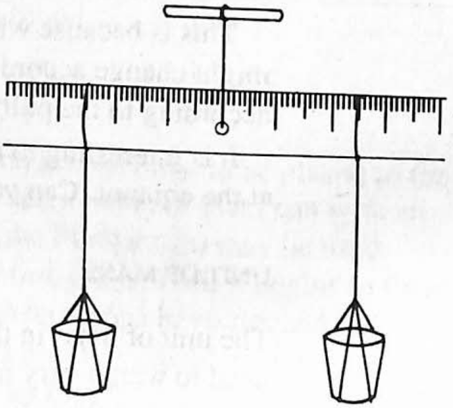
Multiples of the kilogram
100 kg = 1 quintal
1000 kg = 1 metric ton
Sub-multiples of the kilogram
1 gram = 1/1000 kg
1 milligram = 1/1000 gm

Activity 14 : *Devise a simple beam balance and a rough set of weights.*

Things needed : A plastic or wooden coat hanger or a half-metre ruler with a hole in the centre., two plastic shallow dishes for the pans, some string, a few articles of known mass, e.g., a 50 gm packet of tea, a cake of bath soap weighing 100 gms, stones of various sizes. Set up your apparatus to look like either of these diagrams.

You can suspend the beam from a stand. Adjust the positions of the strings so that the beam is horizontal. Now place an object of known mass in the left pan, say a 100 gm soap and balance it with a suitable stone in the right pan. When it appears to be balanced write 100 gm with a crayon on the stone. Repeat this for the 50 gm and 200 gm articles.





Even though weighing with your balance would not be very accurate, it could be used to get a rough estimate of the mass of an object!

1.6 Time

From ancient times the length of the day has been used as the unit of time. The day is divided into 24 hours. One hour contains 60 minutes and one minute contains 60 seconds. The SI unit of time is the second.

THE WATER CLOCK

Water clocks were invented in Egypt about 2,700 years ago. They were used much before the invention of the mechanical and electronic clocks in operation today. The water clock consists of a large glass bowl (Fig.1.13.), with a small hole at the bottom. The surface of the bowl is graduated in minutes and hours. Water is filled in the bowl upto the topmost mark and during the course of the day it gradually trickles down through the hole. The fall in the water level indicates the passage of time.

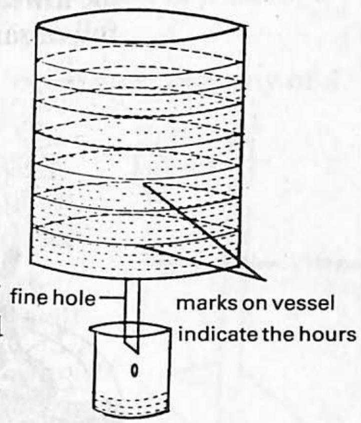
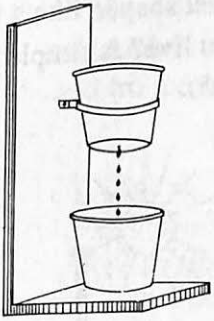


Fig. 1.13 A water clock



Activity 15 : *Construct a simple water clock using the above principle.*
Suggestion : You can use plastic ice-cream cups or any other flexible plastic containers. Make a very tiny hole at the bottom so that it runs for a few minutes. Mark the water level every half a minute with a sketch pen. You can also mark the water level on the cup below the hole into which the water flows.
Does the water always take the same time to flow through?
How can you make it run for a longer period?
Can this clock be used for telling the time?

THE HOUR GLASS (SAND CLOCK)

Hour glasses (Fig.1.14) were used in churches in the early sixteenth century. After the middle of the seventeenth century they were no longer in general use.

This consists of 2 bulbs made of glass interconnected by a narrow opening. The upper bulb contains fine sand. The sand flows from the upper bulb into the lower bulb through the narrow neck in a definite interval of time. When all the sand from the upper bulb has passed into

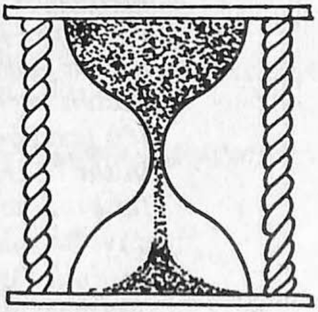


Fig. 1.14 An hour glass

the lower bulb, the apparatus is inverted so that the upper bulb is again full of sand.

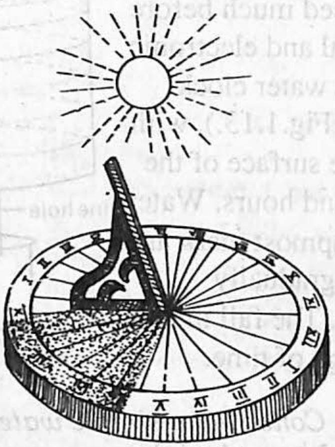
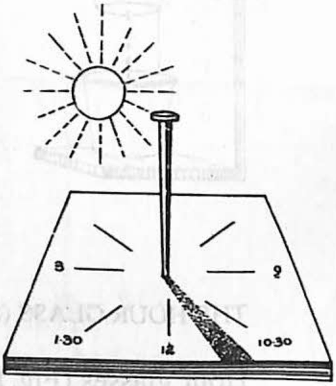


Fig. 1.15 A sundial

SUNDIAL

Sundials were used in ancient days to measure time. It was noticed that the shadow of an object changed in length and moved its position during the day according to the position of the sun. The first sundials were probably poles stuck in the ground with stones to mark its position as the shadow moved during the day. In about 300 BC a Chaldean (native of Chaldea or Babylon) astronomer constructed a new kind of sundial shaped like a bowl.

Is there a sundial in the city where you live? A simple sundial may look like the figure as shown in (Fig.1.15).



Activity 16 *:You can make a sundial for your school. You can indicate on it the time when the bell should be rung at the start of each period.*

Things needed : Wooden block (an old drawing board will do) a long nail or a light rod, a sheet of chart paper and sketch pens to mark the time.

Method : Cut the sheet of chart paper to the size of the wooden block and fix it to the wooden block either with a board pin or with a good adhesive. Hammer the nail into the block of wood as shown in the figure .

If a good adhesive is available, the light rod can be fixed vertically in the board. Calibrate the sundial with a clock and mark the time on the position of the shadow during different times of the day. Be sure to mark the position of the wooden block on the ground. Can this clock be used indoors? Will it work in cloudy weather? Will it need to be changed during the year? Why? How?

Nowadays time is measured with clocks or watches. A pendulum keeps time in a clock.

Galileo discovered the 'isochronous' or 'equal time' property of a pendulum, when he was attending a service in the Cathedral at Pisa. He observed the swinging of a lamp and timed the swings against the pulse rate of his body. He found that the time taken for one to-and-fro motion, i.e., for one oscillation, was the same whether the arc of swing was small or large.

A pendulum can be made by tying a cotton thread to a small metal ball called a 'bob'. The other end of the thread is fixed to a support (Fig.1.16a).

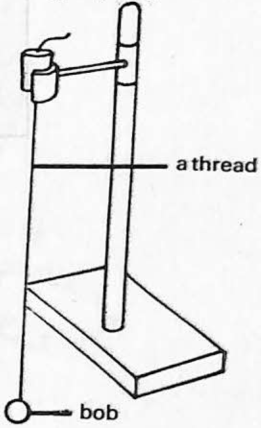


Fig. 1.16 a A pendulum

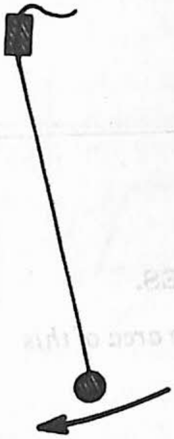


Fig. 1.16 b Oscillation of a pendulum

When the bob is pulled aside slightly and then released, it starts to oscillate (Fig.1.16b). One to and fro motion is called an *oscillation.*

Activity 18 : *Using some plasticine, a string and a marble, make a pendulum. Use the second hand of your wrist watch or a stop clock to find the time it takes for ten oscillations. Alter the angle of swing. Does the time for 10 oscillations change?*

Basic concepts

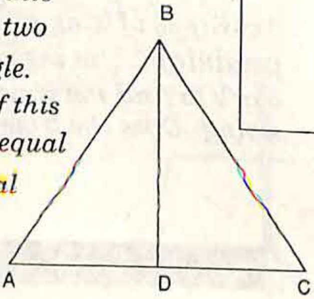
1. The units of length, mass and time are called fundamental units.
2. The metric system of units MKS which is part of the SI system is used all over the world today.
3. The length of straight and curved lines may be measured using a scale, a divider or a string.
4. Area and volume of regular and irregular shapes can be calculated using different methods.
5. Mass is the amount of matter contained in a body.
6. Weight is the force with which the earth attracts a body.

7. People through the ages have devised various means of measuring time.
8. The unit of length in the metric system is the metre (m).
9. The unit of mass in the metric system is the kilogram (kg).
10. The unit of time in the metric system is the second (s).

SOME INVESTIGATORY PROJECTS / ACTIVITIES.

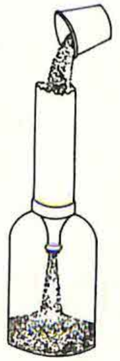
1. *Look at the formulae in Table 1 and calculate the area of this triangle.*
   area = ____________

2. *Now find the area of this triangle without using the above formula. Use a thin sheet of paper to trace the outline. Trace the triangle ABC. Also trace the line BD. Now cut out the triangle you have drawn. Cut the triangle into half along BD. Join the two halves to form a rectangle. Now find out the area of this rectangle which will be equal to the area of the original triangle.*

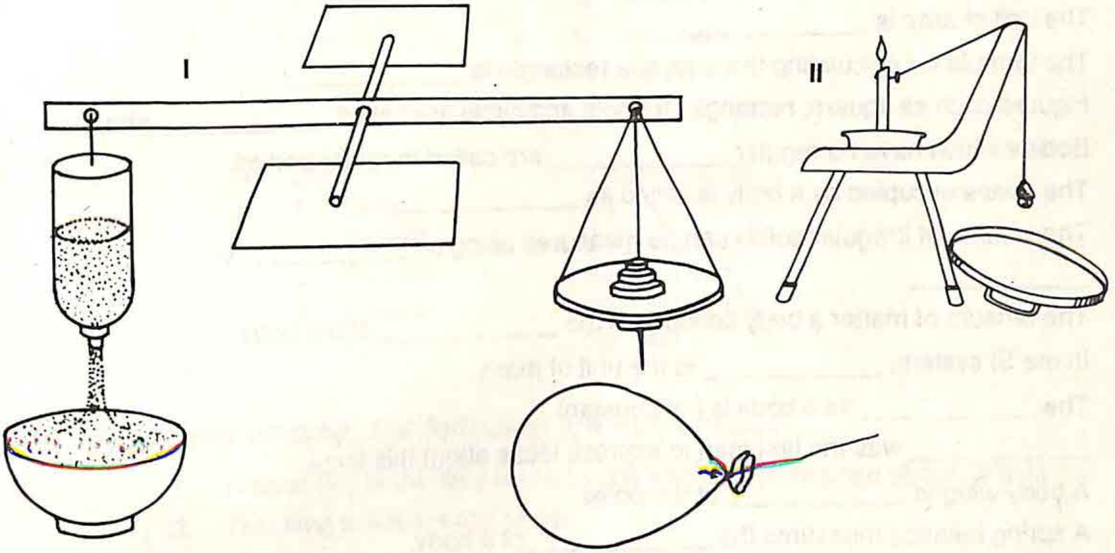


3. *Things needed : An overflow jar, a measuring jar, some water, a piece of string, an irregular shaped body i.e stone or a small toy. Find the volume of the object using the overflow jar.*

4. *Construct a sand clock for your class. .*
   Things needed : Plastic bottles with narrow openings, glass jars, stop clock, fine stand, pen to mark on the glass jar.
   This diagram shows you what to do. Use a stop clock to calculate the time taken.



5. *Study the following diagrams carefully. They are illustration of two methods that have been made up by students (of age 8–10) to construct a simple alarm clock. Sit with a partner and discuss how these works?*



REVISION TIME

I. Fill in the blanks.

1. Physics is the science of ____________.
2. The three basic measurements made in physics are ____________ and ____________ and ____________.
3. The system of measurements used in scientific work is the ____________ system.
4. This system was introduced in ____________ in the year ____________.
5. The units of length, mass and time are called the ____________ units.
6. The units of all the other quantities are called ____________ units.
7. The unit of length in the SI system is the ____________.
8. The unit of mass in the SI system is ____________.
9. The unit of time in the SI system is ____________.
10. Length is the ____________ between two points.
11. Short distances are measured in ____________.
12. Long distances are measured in ____________.
13. A straight line is measured by means of the ____________ scale.
14. While measuring the length of an object, the readings should be taken ____________ from ____________.

15. A curved line can be divided into a number of ____________ lengths.

16. The diameter of a circle can be measured with the help of ____________ and a ____________.

17. The ____________ of a body is called its area.

18. The unit of area is ____________.

19. The formula for calculating the area of a rectangle is ____________.

20. Figures such as square, rectangle, triangle and circle are called ____________ shapes.

21. Bodies which have no regular ____________ are called irregular bodies.

22. The space occupied by a body is called its ____________.

23. The volume of irregular solids can be measured using a ____________ or ____________.

24. The amount of matter a body contains is the ____________ of the body.

25. In the SI system, ____________ is the unit of mass.

26. The ____________ of a body is not constant.

27. ____________ was the first man to express ideas about this force.

28. A body weighs ____________ at the poles.

29. A spring balance measures the ____________ of a body.

30. A common balance measures the ____________ of a body.

II. *1.* *Complete the following :*

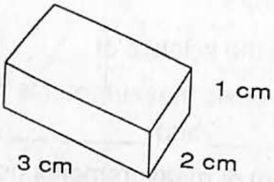
This brick has a length of 3 cm.

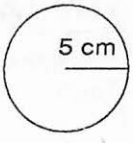
It has a ____________ of 1 cm.

It has a ____________ of 2 cm.

It has a ____________ of 22 cm^2.

It has a ____________ of 6 cm^3.





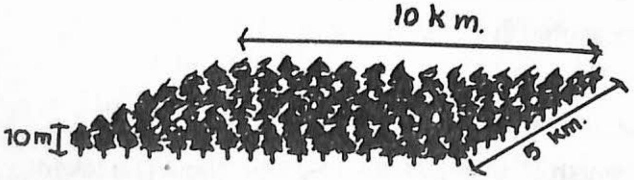
2. *Complete this :*

This circle has a radius of ____________.

It has a diameter of ____________.

It has an area of ____________ (πr^2).

3. *Calculate the area occupied by this forest.*


10 k m.
5 km.
10 m

III. *Match the following :*

A 1. Length – (a) cubic units
2. Area – (b) square units
3. Volume – (c) metres
4. Time – (d) seconds
– (e) newtons

B.

Solid	Volume cu.m.
1. Cube	(a) $\pi r^2 h$
2. Cuboid	(b) a^3
3. Cylinder	(c) $4/3 \ \pi \ r^3$
4. Sphere	(d) $1/3 \ \pi \ r^2 h$
	(e) lbh

IV. *State whether the following are true or false :*

1. A solar day is the time taken by the earth to rotate once about its axis.
2. This time is always the same.
3. The space occupied by a body is its mass.
4. The extent of a body is called its area.
5. The units of area and volume are derived from the unit of length.
6. The volume of a cuboid can be measured by measuring two lengths.
7. The weight of a body is the same at the poles and the equator.
8. Not all bodies possess mass.
9. Both the mass and weight of a body may be found with the help of a common balance.

V. *Choose the correct answer.*

An overflow jar is used to

a. Measure the volume of liquids. b. Measure the area of a solid. c. Measure the volume of a solid.

VI. *Correct the false statements.*

a. The second is a unit of time. b. Duration (time) is measured in degrees centigrade. c. The gram is a unit of mass. d. Liquid measurements are made in litres, or cubic metres.

VII. *Answer the following questions in one or two sentences.*

1. What does 'physics' discuss?
2. What are the two advantages of the metric system?

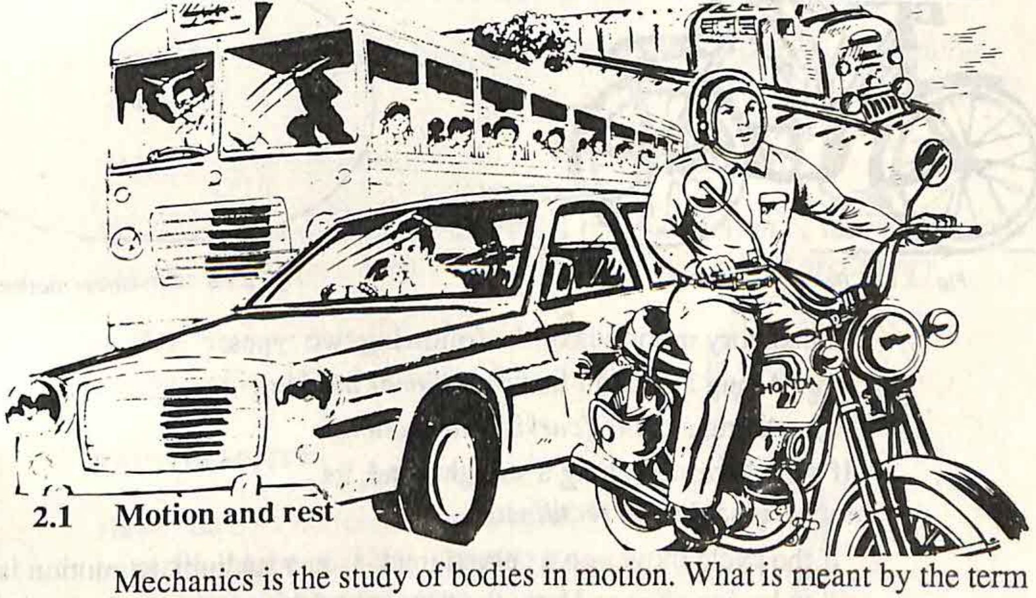
3. How are the areas of regular shapes calculated?
4. Why are the units of length, mass and time known as the fundamental units?
5. What is the difference between mass and weight?

VIII. *Answer the following questions :*

1. What is a unit?
2. Name the methods used to measure curved lines.
3. What is parallax error?
4. How is the curved line measured by a thread?
5. Describe the divider method to measure the length of a curved line.
6. Describe a method to measure the diameter of a circular body.
7. Give some examples of regular figures.
8. How do you find the volume of a solid using a measuring jar?
9. Write a few lines about the pendulum clock.
10. Calculate the area of a container which has the following dimensions :
    length = 20
    breadth = 10 cm
    height = 15 cm (*Ans* : 1300 cm^2)
11. A test tube is 10 cm high and has a diameter of 2 cm. Calculate its volume. (*Ans*: 31.4 cm^3)
12. A triangle has a base of 15 cm and a height of 10 cm. What is its area? (*Ans* : 75 cm^2)
13. What is the volume of a sphere of radius 30 cm. (*Ans* : 113040 cm^3)

2 Mechanics

Idea of motion and rest - types of motion - force - types and effects - measurement of a force - work - energy - machines - levers - pulleys.



2.1 Motion and rest

Mechanics is the study of bodies in motion. What is meant by the term motion? A moving car, train, cycle or aeroplane gives us an idea of motion. When there is a change in the position of a body with respect to other bodies around it, then the body is said to be in *motion.* To a person seated in a moving train, objects which are outside such as trees, lamp posts and buildings would seem to be moving, while the person sitting next to him would seem to be at rest. Hence, motion is a relative term and we can describe the motion of a body only with respect to other bodies. A body is said to be at *rest* when it does not change its position with respect to time.

15450

Type of motion

There are several types of motion. Some of these are:

TRANSLATORY MOTION

In all the given examples above, the bodies, i.e., train, car, cycle, etc. move as a whole from one place to another. Thus every point on the moving body moves through the same distance in the same span of time. Such a motion is said to be *translatory motion.*

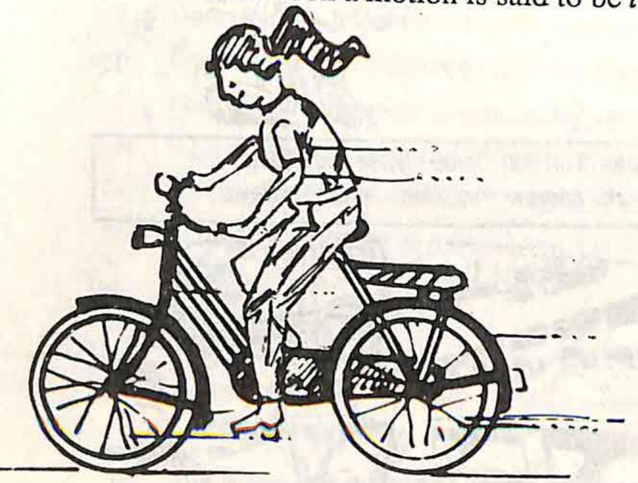


Fig. 2.1 a Rectilinear motion

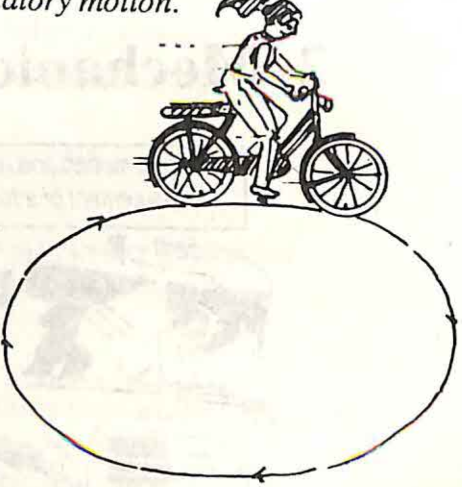


Fig. 2.1 b Curvilinear motion

Translatory motion is of the following two types:

(i) Along a straight line *(rectilinear motion).*

(ii) Along a curve *(curvilinear motion).*

If a cycle moves along a straight road, its motion is said to be *rectilinear.*

If the cycle moves on a curved track as in a stadium, its motion is said to be *curvilinear*. Here, the distance of the moving body from the centre remains the same but its direction is continuously changing.

Activity 1 : *Give two examples of rectilinear motion and curvilinear motion. Draw one example to demonstrate each type.*

ROTATORY MOTION

Motion in which the body does not move as a whole from one place to another but rotates in the same place is called *rotatory motion.*

The motions of a merry-go-round or an electric fan are examples of rotatory motion. (Fig. 2.2)

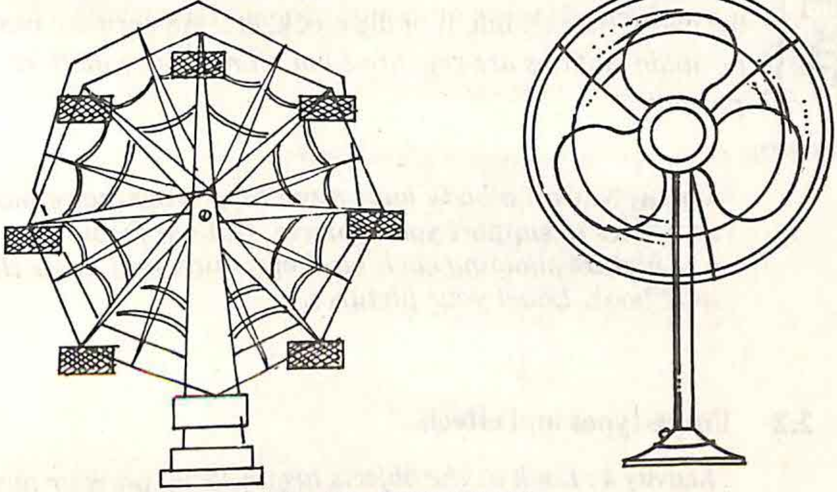


Fig. 2.2 Rotatory motion

Activity 2 : *Make a list of as many examples of rotatory motion as you can.*

OSCILLATORY MOTION

You have already learnt in Chapter 1 that the motion of the pendulum is a to and fro motion. Such a to and fro motion is called *oscillatory motion.* So the pendulum of a clock is an example of oscillatory motion (Fig. 2.3).

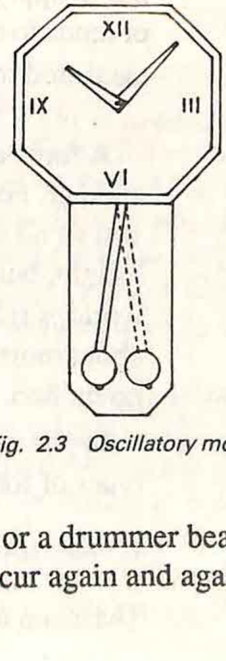


Fig. 2.3 Oscillatory motion

RANDOM MOTION

Have you ever noticed the motion of butterflies or bees? They seem to move about in a haphazard manner. They move in all possible directions. Such motion is called *random motion.*

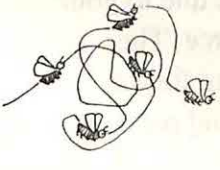


Fig. 2.4 Random motion

REPETITIVE MOTION

If you observe the arms of a soldier marching, or a drummer beating a drum you will notice that the same motions occur again and again. Such motion is *repetitive motion.*

2.5 Repetitive motion

Sometimes repetitive motion takes place after regular intervals of time. It is then called *periodic motion.* The motion of the moon round the earth, the pendulum of the clock, etc. are periodic motions. *All periodic motions are repetitive but all repetitive motions are not periodic.*

Activity 3 : *Can a body have more than one kind of motion? Give examples to support your answer. Cut out from magazines at least one picture showing each kind of motion and paste these in your note book. Label your pictures.*

2.2 Force-types and effects.

Activity 4 : *Look at the objects around you, on your desk, in your classroom and outside your classroom. Are they at rest or in motion? If they are at rest how can they be made to move? If they are in motion how can you stop them from moving?*

A body by itself cannot move from rest, or change its speed. A book kept on the table cannot move by itself unless someone pushes or pulls it. The push or pull applied to it is called *force*. Hence, if a body is to start moving from rest or if it is to change its speed while moving, one has to apply some force on it. *Force* is defined as anything that changes or tends to change the state of rest or motion of a body. Force is measured in *newtons*.

A force cannot exist by itself. It can only be exerted by one body on another. For example, we know that the earth pulls you and me. When you sit on a chair you exert a push on the chair downwards due to your weight, but the chair pushes you upwards with an equal force. The world is full of forces acting on everything. Luckily, we can forget about most of them, since they cancel each other's effect and produce no motion.

In our study of Physics we realise that there are several different types of forces. Some of them are:

1. MECHANICAL FORCE

These are forces of push or pull on a body to make it change its motion.

2. ELASTIC FORCE

These are forces which act in a stretched rubber band or spring*(Fig.2.6)*. The force which tries to bring the body back to its normal size or shape is called *elastic force*.

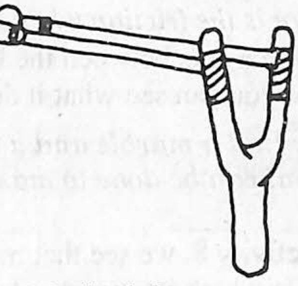


Fig. 2.6 Elastic force

3. MAGNETIC FORCE

If we keep some iron nails near a magnet, we find that they attach themselves to the magnet *(Fig.2.7)*. A magnet exerts a pull on the iron nails kept near it. This pull is called *magnetic force*.

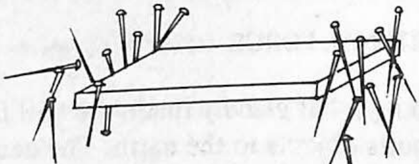
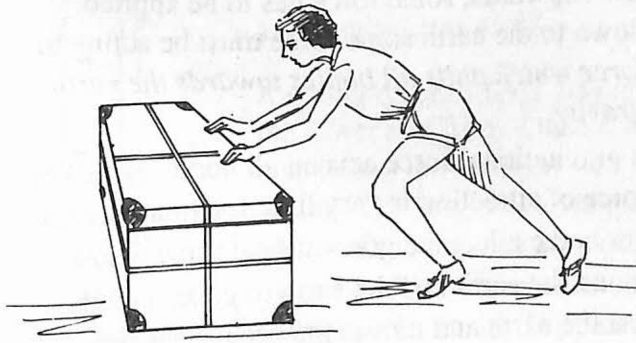


Fig. 2.7 Magnetic force

Activity 5 : *Questions to think about.*
What is needed to make something move? What is needed to make something stop? If you throw a ball to your friend what force do you use? Can you make your book move without touching it? Can you name a force which makes objects like nails and pins move without being touched ? If you use your catapult to knock berries off a tree, what force are you using?



Activity 6 : *Roll a ball on the floor. Push a toy wagon on the table. Move a heavy box on the floor. Why does the ball stop rolling? Why does the wagon stop moving? Did you feel any resistance as you moved the block of wood?*

4. FRICTIONAL FORCE

The force of friction is defined as the force that offers resistance to motion. It is the force that made the wagon and the rolling ball stop moving. There is friction when two objects push or rub against each other. *Where is the friction when the block moves on the floor?* Frictional force acts between the block and the floor. You cannot see friction, but you can see what it does.

Activity 7 : *Roll a marble and a ball on the floor. Which stops first? Why? What can be done to make the block of wood easier to move?*

From Activity 8, we see that rough objects gives us more friction. The glass marble which is smoother has less friction between it and the floor. Morever, it is important to note, rolling a body causes less friction than sliding it.

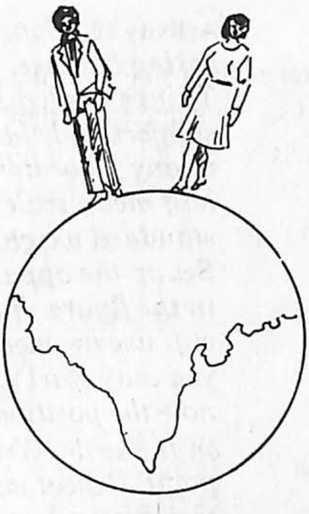
Activity 8 : *Hold a ball in your hand and then let it go. What happens? What makes it fall?*
Throw the ball upwards. Why does it come down?

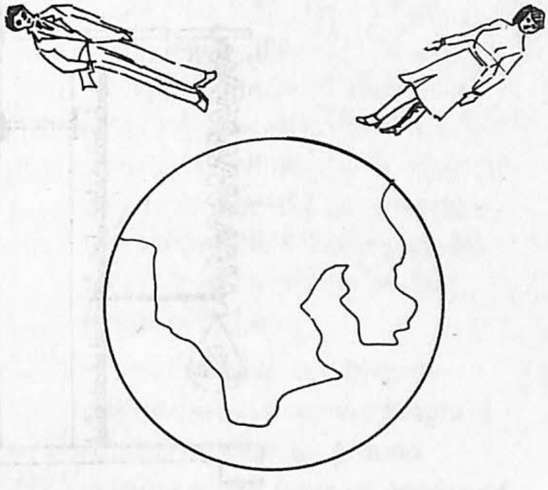
5. GRAVITATIONAL FORCE

We realise, today, that *gravity* made the ball fall. Gravity is a *pulling force* which pulls objects to the earth. The centre of the earth is deep inside the earth. It acts like a huge magnet pulling all objects towards it. We cannot actually see gravity but we can see what gravity *does*.

You may have heard this well-known story told about Sir Issac Newton. Once, while he was sitting in his garden under an apple tree, he was hit on the head by a falling apple. This made him wonder why an object should always fall downward, and not go upwards. He reasoned that if a body is to be thrown upwards, some force has to be applied. So, when a body comes down to the earth some force must be acting to pull it downwards. *This force which pulls all bodies towards the earth is known as the force of gravity.*

Newton stated that this gravitational force acts on all bodies, small or large. The gravitational force of attraction is very little for small bodies but is quite large for bigger bodies. It is the gravitational force which causes the moon to go around the earth and the earth to go around the sun. The moon also attracts the earth and moves the oceans causing tides.





Activity 9 : *Questions to think about.*
What would happen without gravity? What would happen to the balls you throw up? What would happen to the books you drop? What would happen to you?

2.3. Measurement of a force

We saw in the last section that the force of gravity pulls objects towards the centre of the earth. The weight of a body is due to this force of attraction exerted by the earth on the body. The common balance helps us to measure the mass of a body and *not* its weight. This is because the force of gravity acts equally on both pans of the balance and therefore the effect is neutralised. If we use a spring balance (which has only one pan), we can only measure the weight of the body because it is the force of gravity that acts on the body here.

THE SPRING BALANCE

A spring balance (Fig. 2.8), consists of a spring with a hook attached to the lower end from which a weight can be suspended. A pointer is attached to the spring which moves over a graduated scale on the casing. The body to be weighed is suspended from the hook. The spring gets stretched due to the earth's pull on the body and the pointer moves over the scale. The position of the pointer on the scale indicates the weight of the body. The extension of the spring is proportional to the weight of the body.

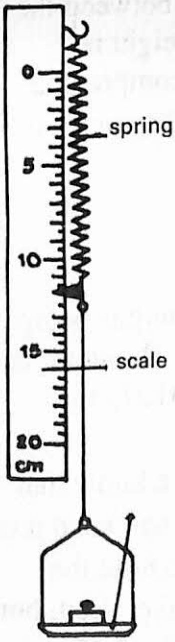
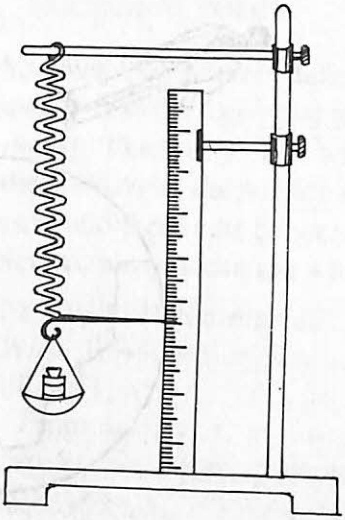


Fig. 2.8 A spring balance



Activity 10 : *Construct a simple spring balance.*
Things needed : A stand with support and clamp (available in any laboratory) a spring, a half metre scale, some standard weights.
Set up the apparatus as shown in the figure. If the spring is stiff use heavier weights, if not you may start with 1 gm and note the position of the pointer on the scale. Write 1gmf at this point. Repeat with various weights and write the value against the pointer on the scale.

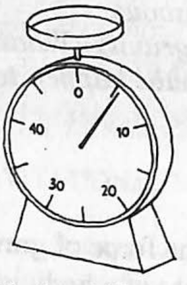


Fig. 2.9 A weighing machine

WEIGHING MACHINES

Weighing machines are also used for measuring weight (Fig 2.9). A weighing machine, like a spring balance, consists of a spring, but there is a difference between the two. In a spring balance, the spring is extended when a weight is suspended, whereas in a weighing machine the spring is compressed when a weight is placed on the pan. The compression of the spring is proportional to the weight of the body.

2.4 Work

The word 'work' brings to our minds the idea that something is being done. You all know that in cricket we use the word 'run'. Though it is an ordinary word, it has a special meaning in cricket. Similarly the word 'work' has a special meaning in physics.

When we see a man walking with a load on his back, we know that he is doing work. If you lift a heavy parcel from the floor and keep it on the table you do some amount of work. If you are asked to hold the same parcel in your arm for some time, you will begin to feel tired, but in the language of science you have not done any work (Fig. 2.10).

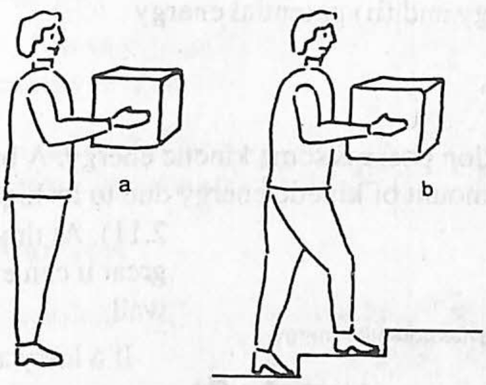


Fig. 2.10 a No work being done

Fig. 2.10 b Work done against gravity

A force acting on a body is said to do work when it produces motion of the body. When the body moves in the direction of the force, work is said to be done by the *force*. When a body moves opposite to the direction of the force, work is said to be done *against the force*.

For example, if a body is dropped from a certain height it moves towards the ground because of the force of gravity of the earth pulling it downwards. Here work is done by the force because the body moves in the same direction in which the force acts.

When a man raises a load to a certain height, work is done against the force of gravity because the load moves opposite to the direction of the force of gravity. Hence,

Work done = force acting × distance moved.

Work is measured in joules,i.e., joule is the unit of work.

Activity 11 : *Questions to think about.*
Is work done when we climb stairs ? Is this work done by or against a force?. Which force is acting? Is work done when you push your desk? Is this work done by or against a force? Do you work when you try very hard to push a heavy rock, but don't succeed? Do you work when you are thinking?

2.5 Energy

The ability to do work is called energy. A book on a shelf possesses energy, for it may fall on a vase and break it. Also, in falling, the book has moved through a distance, in the direction of the force (i.e., it has been displaced from its initial position). Hence, work is said to be done.

Energy can be seen in various forms. Some of them are:

1. Mechanical energy 2. Heat energy 3. Light energy 4. Sound energy 5. Magnetic energy 6. Electric energy 7. Atomic energy 8. Chemical energy.

There are two types of mechanical energy:

(i) kinetic energy and (ii) potential energy

KINETIC ENERGY

All bodies in motion possess some kinetic energy. A bullet fired from a gun has a large amount of kinetic energy due to its high speed (Fig. 2.11). At times its energy is so great it can even penetrate a wall.

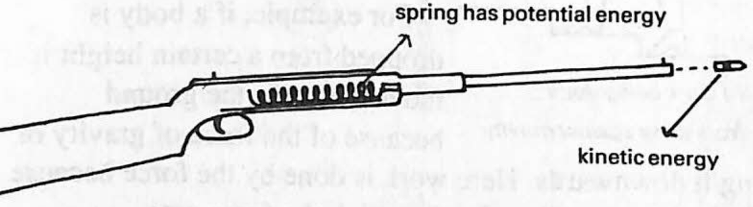


Fig. 2.11 A bullet possesses kinetic energy

If a lorry and a car are moving with the same speed, the lorry possesses more kinetic energy than the car, since it can do more work. So the kinetic energy depends on the mass of the body and the speed of the body.

POTENTIAL ENERGY

Potential energy of a body is the energy possessed by it due to its position or state. The work done in bringing the body to that particular position or state is stored up in it as potential energy.

A wound spring, like a watch spring *(Fig. 2.12)* has potential energy because, in returning to its natural shape, it does work in keeping the watch going.

ig. 2.12 Potential energy in a coiled watch spring

A hammer in the raised position has potential energy because work has to be done in order to lift it against the force of gravity. This energy can be used to drive nails into wood, for instance *(Fig. 2.13)*.

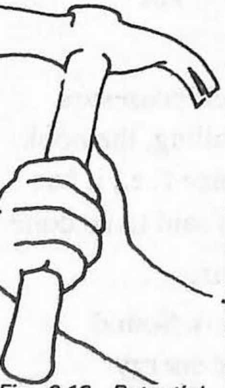


Fig. 2.13 Potential energy in a raised hammer

You now know that energy can exist in many forms. When we want a particular form of energy we can get it only from some other type of energy. That is to say, we cannot 'create' energy. *We can only change it from one form to another*. For example, to obtain steam for the running of a steam engine, the chemical energy of coal is converted to heat energy, and the heat energy of steam is transformed into the mechanical energy of the engine.

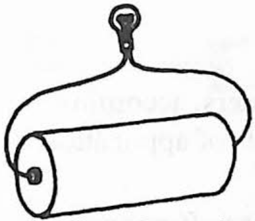


Fig. 2.14 Conversion of electrical and chemical energy

In an electric bulb, electrical energy is converted into heat and light energy.

In a storage cell, chemical energy is transformed into electrical energy *(Fig. 2.14)*.

Activity 12 : *Give one example of each form of energy.*
What forms of energy do we get from the sun?

2.6. Machines

Activity 13 *: Do the following at home:*
Close the lid of a tin very tightly and then open it. Note down what you used to open it?
Open an aerated soft drink bottle. What did you use to open it?
Try and loosen a screw which is too tight.
Cut a piece of cloth into two pieces.

In all the above activities, you will notice that you used some kind of implement to make your task easier i.e., a spoon, bottle opener, scissors, etc. A device *which makes work easier for us, usually by overcoming a large resistance using a small force, is called a machine.*

Have you watched a heavy stone being lifted by a long rod which is slightly bent at one end? This long rod is called a *crowbar* and is the simplest form of a lever. The rod is supported at a point called the *fulcrum.*

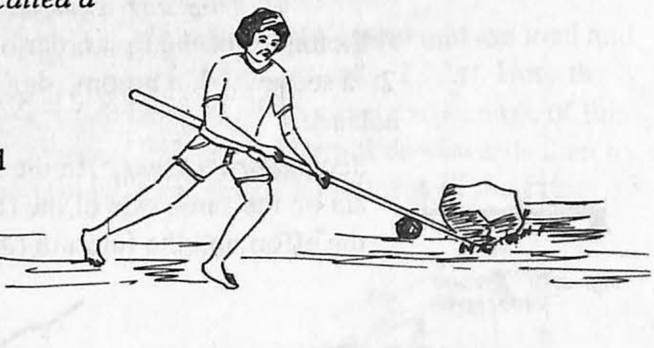


Fig. 2.15 Using a crowbar

THE LEVER

This is a rigid bar which is free to turn about a fixed point called the fulcrum. The resistance that has to be overcome by the lever is called the *load,* and the force applied to overcome the resistance is called the *effort.* The distances of the effort and the load to the fulcrum are called the *effort arm* and *load arm* respectively.

ORDERS OF LEVER

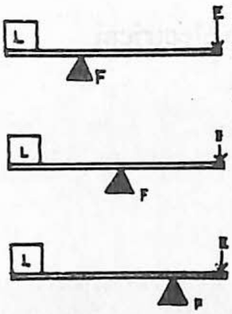


Fig. 2.16 First order lever

Levers may be divided into three different classes or orders, according to the position of the fulcrum and according to the points of application of the effort and the load.

First order lever: In the first order lever *(Fig. 2.16)* the effort and load are on opposite sides of the fulcrum. The fulcrum is between the load and the effort. If the fulcrum is arranged to be near the load then a large load is overcome by a small effort.

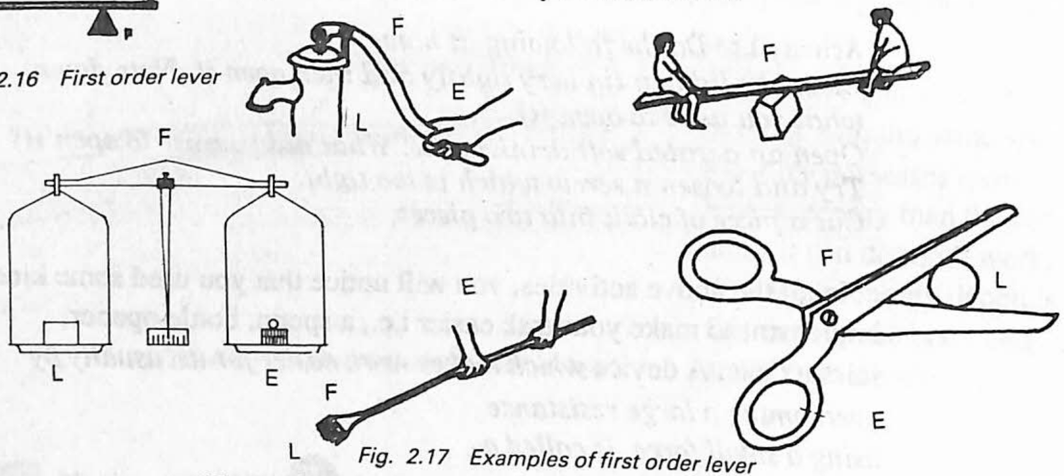


Fig. 2.17 Examples of first order lever

Examples of the first order of lever are 1. the handle of a pump, 2. a seesaw, 3. a broom, 4. a pair of scissors, and 5. a common balance.

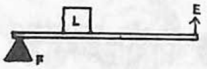


Fig. 2.18 Second order lever

Second order lever : In the second order lever, both effort and load act on the same side of the fulcrum, and the load is situated between the effort and the fulcrum *(Fig. 2.18)*.

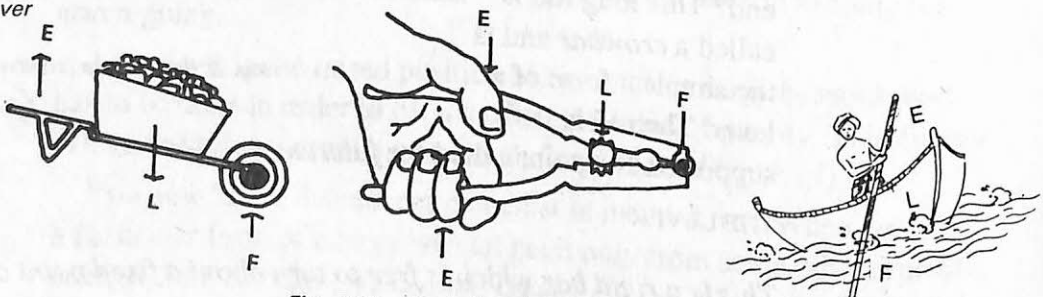


Fig. 2.19 Examples of second order lever

Examples of the second order of lever (*Fig. 2.19*) are 1. the wheel barrow, 2. a pair of nut-crackers, and 3.the oar of a boat.

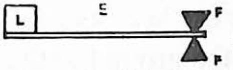


Fig. 2.20 Third order lever

Third order lever : In the third order lever the effort acts between the fulcrum and the load *(Fig. 2.20).*

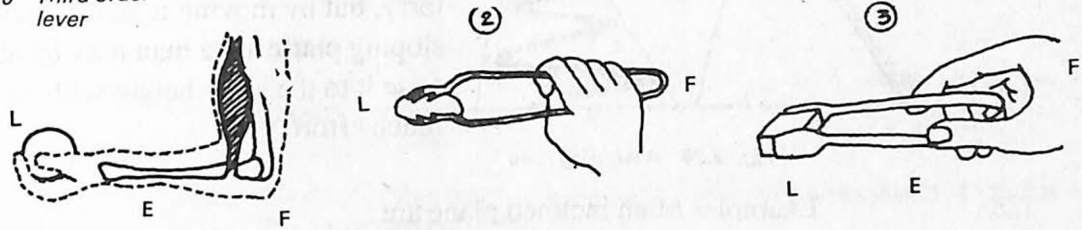


Fig. 2.21 Examples of third order lever

Examples of the third order lever *(Fig. 2.21)* are

1. the human arm, 2. a pair of coal tongs, and 3. a pair of sugar tongs.

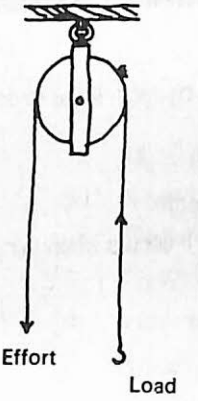


Fig. 2.22 a A pulley

THE PULLEY

A pulley consists of a wheel with a grooved rim. The wheel rotates freely about an *axis* (the fulcrum) supported within a framework called a *block.*

A single fixed pulley operates as a first order lever.

Single fixed pulley : A rope is passed over the wheel and the load and effort are applied one to each end of the rope *(Fig. 2.22a).* Here the effort used for lifting is equal to the load. The main advantage of this kind of pulley is that it is more convenient to pull downwards than to lift upwards. Thus we are able to change the direction of the effort *(Fig. 2.22b).*

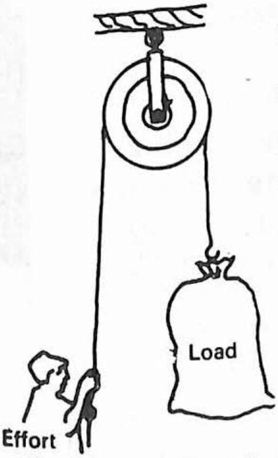


Fig. 2.22 b A single fixed pulley

THE INCLINED PLANE

This is a very simple form of machine generally used to lift loads conveniently *(Fig. 2.23).* It is chiefly used to load and unload heavy objects from a lorry.

When used in this way, the inclined plane usually consists of a plank or platform which is extended from the tail-end of the lorry to the

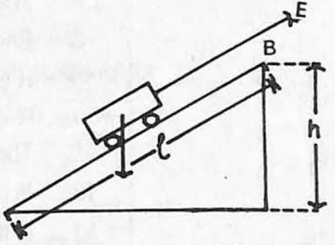


Fig. 2.23 The principle of the inclined plane

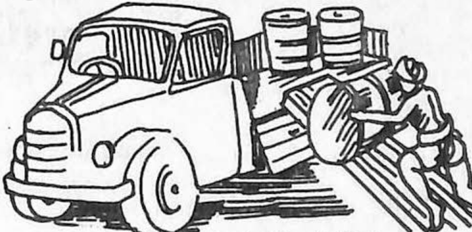


Fig. 2.24 An inclined plane

ground. A load may be too heavy to raise it vertically from the ground to the lorry, but by moving it gently along a sloping platform, a man may be able to raise it to the same height without too much effort.

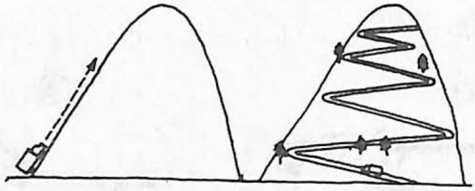


Fig. 2.25 A winding road

Examples of an inclined plane are

1. a winding road leading to the top of a hill *(Fig. 2.25).*
2. a staircase leading to the top of a building.

Basic concepts :

1. An object cannot move by itself nor can it stop by itself. It needs a force to do this.
2. Force may push an object or pull it.
3. Gravity is the force that pulls things to the centre of the earth.
4. Friction is a force that makes things slow down and stop. It occurs when things rub against each other.
5. Weight can be measured with a spring balance.
6. Work is done if a body moves when a force acts on it.
7. The unit of work is joules.
8. The ability to do work is called energy which can be in various forms.
9. Energy can be changed from one form to the other.
10. A simple machine is a device which makes work easier. The lever is a simple machine.
11. There are three types of levers.
12. In the first order lever the effort and load are on either side of the fulcrum
13. In the second order lever the effort and the fulcrum are on either side of the load.
14. In the third order lever the load and fulcrum are on either side of the effort.

SOME INVESTIGATORY PROJECTS / ACTIVITIES

1. *Imagine you are at the circus. Make a list of all the different kinds of motion that you see there.*
2. *Questions to think about.*
   Is friction always harmful? When is friction not a help? How can we get less friction? List two ways in which friction helps us and two ways where it is not a help.
3. *Find out if there is a compression balance in your house or school. Try weighing a few items with it.*
4. *Collect pictures of the following : tongs, nutcracker, human arm, bottle opener, wheel barrow and a pair of scissors. Arrange them according to the order of lever each belongs to and paste them in your note book. Mark the position of load, effort and fulcrum on each picture. If pictures are not available then draw them in your note book.*

REVISION TIME

I Fill in the blanks.

1. Mechanics in the study of bodies in ________.
2. A body is said to be at rest when it does not ____________ its position with respect to ______________.
3. Speed is the ______________ travelled by a body in ______________.
4. Work is said to be done if ______________.
5. Speed is measured in ______________ in the SI system of units.
6. The force which tries to bring a body back to its normal shape is called __________.
7. The capacity of a body to do work is called ______________.
8. Kinetic energy is the energy possessed by a body because of its ____________.
9. Potential energy is the energy possessed by a body because of its ____________.
10. In an electric bulb, electrical energy is converted into ______________ and ______________.
11. A raised hammer possesses ______________ energy.
12. A bullet possesses ______________ energy.
13. A watch spring possesses ______________ energy.
14. A body falls due to ______________.
15. When one body moves over another, the force acting is called ______________.
16. Frictional force is a ______________ force.
17. Gravitational force is a ______________ force.

18. K.E.depends on _____________ and _____________.

19. P.E.depends on _____________.

20. i) A pair of scissors is an example of ____________.

ii) A wheel barrow is an example of _____________.

iii) A human arm is an example of _____________.

iv) A seesaw is an example of _____________.

v) An oar of a boat is an example of _____________.

II *Choose the correct answer.*

1. Work is done when a. a force is exerted b. something moves. c. something is lifted.
2. The force which resists the sliding of one object over another is a. friction. b. inertia. c. resistance. d. work.
3. The fixed point of a lever is called the a. axle. b. effort. c. fulcrum. d. wheel.
4. A single fixed pulley is used to
   a. increase speed.
   b. increase the efficiency.
   c. change the direction of the force applied.

III *Match the following*

1. A wound clock
2. A moving bullet
3. Coal

a. kinetic energy
b. potential energy
c. chemical energy
d. light energy
e. heat energy

III *Answer the following questions.*

1. What is a simple machine?
2. Why are simple machines used? Give two reasons.
3. Describe the lever as one of the three simple machines.
4. Describe the inclined plane as one of the three simple machines.
5. What are the different types of energy you know of?
6. When is work said to be done?
7. What is 'force'?
8. What is the force of gravity? Is it useful to us?
9. What is frictional force?
10. What is energy?
11. What is kinetic and potential energy?
12. What is transformation of energy? Give three examples.

3 Hydrostatics

Density - thrust and pressure - liquid pressure - liquid seeks its own level - spirit level - floating - atmosphere - existance of atmospheric pressure.

3.1 Density

Look at your classroom. How many pupils are seated in it? If 20 more pupils were to join the class would there be room for all? If another 20 pupils came after that, you would certainly be packed close together.

Though the size of your classroom remains the same, the number of pupils in it could be less or more depending on whether they are sitting far apart or close to each other.

Similarly, if we study the population of people in a place we realise that some cities for example are more densely populated than rural areas. This means that within the same area the number of people in a city are more than the number in a village. In both these examples we see that though the area remains the same the density has changed.

Similarly, if we take the same volume of different substances and weigh them we find they will not weigh the same. This is because in some substances the matter is packed more closely than in others.

Consider the mass of one cubic centimeter of each of the following substances:

one c.c. of gold weighs 19.3 gm
one c.c. of silver weighs 10.5 gm
one c.c. of cork weighs 0.2 gm
one c.c. of water weighs 1 gm

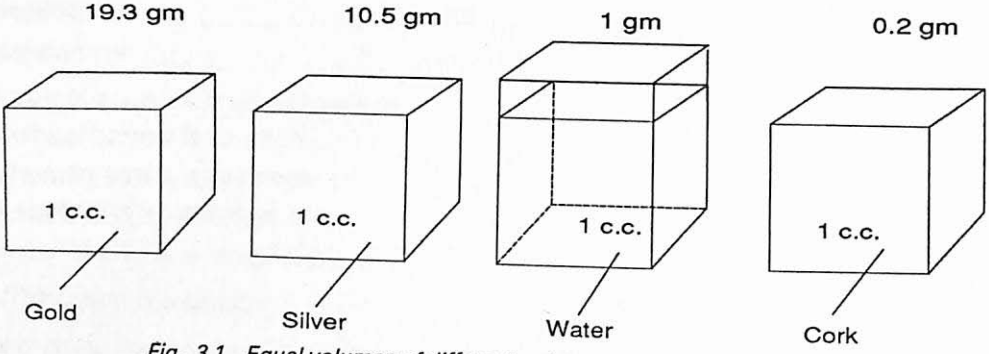


Fig. 3.1 Equal volumes of different substances vary in weight

You will notice that although the volume of all these substances is the same, the weight varies, i.e., for 1.c.c., the weight of gold is the most while that of cork is the least. *(Fig.3.1)*. We usually say that the *density* of gold is more than the density of silver or cork. This means that the matter is packed more closely in gold or silver than in cork or water. Hence, if we consider equal volumes of different substances, the substance with the greatest mass has the highest density and that with the lowest mass has the lowest density. *The mass of a substance contained in unit volume (1 c.c. or 1 m^3) is called its density.*

$$\text{Density} = \frac{\text{mass}}{\text{volume}}$$

Since the unit of volume in the CGS system is in cubic centimetre, the density of a substance is the mass in one cubic centimetre of it. Since mass in the SI system is measured in kilograms, the density is expressed in kg./m^3 . Sometimes it is more convenient to express it in gm/c.c

We also realise that equal volumes of different kinds of liquids or gases do not weigh the same, that is, they do not contain the same amount of matter and therefore have different densities.

Activity 1 : *Take equal blocks of different materials from your school laboratory. Weigh them in the rough beam balance which you constructed in the previous lesson.*
Do they have the same masses? Why?
Which block has the greatest density?
Which block has the least density?

The formula, density $= \dfrac{\text{mass}}{\text{volume}}$ ____________(1)

can also be expressed as mass = density × volume ____ (2)

$$\text{or, volume} = \frac{\text{mass}}{\text{density}} \qquad \text{-----------} \quad (3)$$

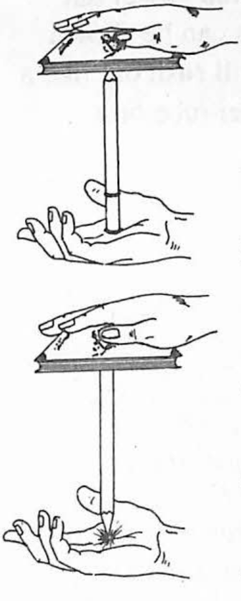
So, if any two of the three quantities are known, we can determine the third by simple arithmetic.

Table giving the densities of some substances

Substance	*kg/m^3*	*gm/c.c*
Gold	19300	19.3
Lead	11300	11.3
Silver	10500	10.5
Cobalt	8900	8.9
Paraffin Wax	900	0.9
Ice	909	0.9
Mercury	13600	13.6
Kerosene Oil	800	0.8
Water	1000	1.000

Activity 2 : *a. A piece of ice weighs 90 gms. It's volume is 100 c.c. Find its density.*
b. Find the volume of 9 gms of silver of density 10.5 gms/c.c.
c. What is the mass of 20 c.c. of mercury of density 13.6 gm/c.c.
Use the expressions 1., 2. and 3. above to do your calculations.

3.2 Thrust and pressure



Activity 3 : *Take a sharpened pencil and hold it standing up with its flat end resting on your palm. Now place a fairly heavy book on the top. The weight of the book exerts a force on your palm. Now invert the pencil and repeat the experiment as before. This time you will experience a sharp pain on your palm. Can you explain why this happens?*

We realise from the above experiments that what matters is not the force alone but the area over which it acts.

The force acting over unit area is called *pressure.*

In the second experiment above, the weight of the book was distributed on a smaller area, i.e., the pencil point.

The force (weight of book) which acts normal to the surface, i.e., at right angles to the hand is called *thrust.*

When a block of iron rests on a table *(Fig.3.2)* its weight acts downwards and presses on the surface of contact of the table. This pressing force which acts normal to the surface and is distributed over the entire area of the surface is the *thrust* or *thrust is the force acting*

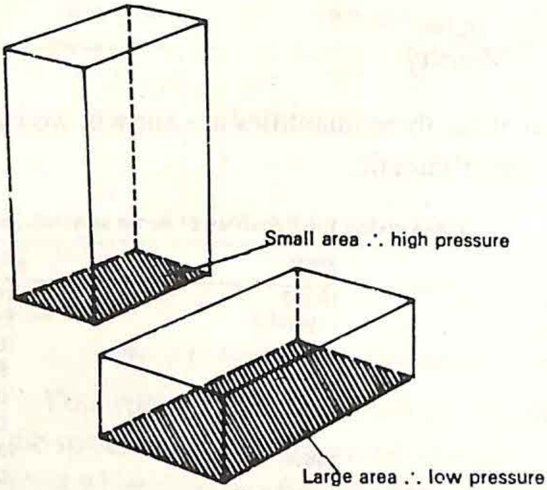


Fig. 3.2 Thrust

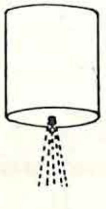
normal to a surface. (Normal or perpendicular means 'at right angles'.) In the SI system thrust is measured in *newtons.* Thrust per unit area is termed *pressure.* It is measured in newtons/m^2

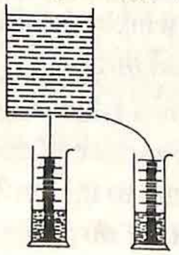
Activity 4 : Questions to think about.
Why does the elephant have such broad feet?
Do you know of any other animals whose feet spread out as they walk?
Why, do you think this happens?
Why is it easier to cut with a sharp knife than with a blunt one?
Why do we use pointed implements to pierce holes in objects?

3.3 Liquid pressure

An iron block placed on a table exerts a downward pressure on it and does not exert any sideways pressure. If, however, water is contained in a vessel, the liquid exerts pressure in all directions. For instance, it exerts not only a downward pressure on the bottom of the vessel but also a sideway pressure on the walls of the vessel. This can be shown by making an opening in a wall of the vessel. Water will rush out like a jet with force from the hole. Similarly, thin India-rubber tube or a balloon when filled with water bulges out.

Activity 5 *: Pierce a tiny hole with a small nail in the bottom of a tin can and pour some water into the can. What happens? Why?*
When the tin is empty, push it into a small bucket of water. What happens? Why? What can you say about liquid pressure from these two experiments?

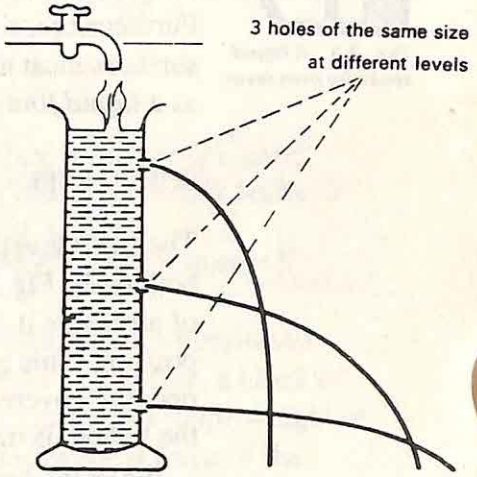




Activity 6 *: With the same nail pierce another hole in the side of the can just near the bottom. Pour water into the tin and immediately place two measuring cylinders beneath the jets of water which spurt out of each opening.*

When about 1/3 of the measuring jars are filled remove them simultaneously.
Is the volume of water in both the measuring jars the same? Since both the holes are at the same depth what can you say about liquid pressure from this?

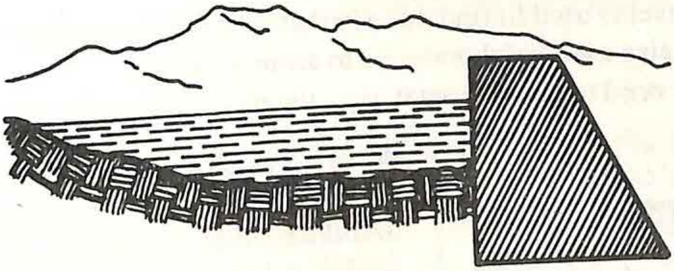
Activity 7 : *Take a tall glass or metal jar having three openings at different depths as shown in the Fig. Fill the jar with water. It will be found that jets of water come out from the holes showing that the liquid exerts a lateral pressure. It will also be seen that the water rushes out with a greatest force from the hole at the bottom, with less force from the hole at the center and with least force from the hole at the top. What does this show?*



From the above experiments we may conclude that

1. A liquid exerts pressure in all directions.
2. Liquid pressure is the same at a given depth.
3. Liquid pressure increases with depth.
4. Liquid pressure is exerted equally in all directions.

From which of the above experiments is each conclusion drawn from?



Activity 8 : *Questions to think about :*
Look at the figure.
Why is a dam broader at the base than at the top?
Why do divers working at great depths wear steel diving suits?

A LIQUID SEEKS ITS OWN LEVEL

Several glass vessels of different sizes and shapes can be connected at their bases as shown in *Fig.3.3.*

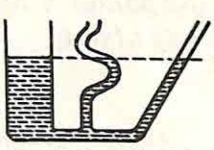


Fig. 3.3 A liquid seeks its own level

When water is poured in, all the vessels fill to the same depth at the same time. This is because the liquid pressure at any depth is the same. Otherwise the level of water in the three tubes would vary according to the pressure in each tube and would be more in one tube than another. Furthermore, since the depth of water in all the vessels is the same their surfaces must all lie in the same horizontal plane. This fact is referred to as a *liquid finding its own level.*

SPIRIT LEVEL

The spirit level is a short glass tube very slightly curved and closed at both ends. *Fig. 3.4.* The tube is filled with spirit so that there is a bubble of air inside it. The air bubble will always tend to occupy the highest position. This glass tube is fixed in a wooden or metal box, with a small opening covered with a glass plate. The highest position occupied by the bubble is marked on the glass tube.

When the box is placed on a plane horizontal surface, the bubble occupies exactly the highest position. If the surface is not horizontal the bubble will occupy some other position.

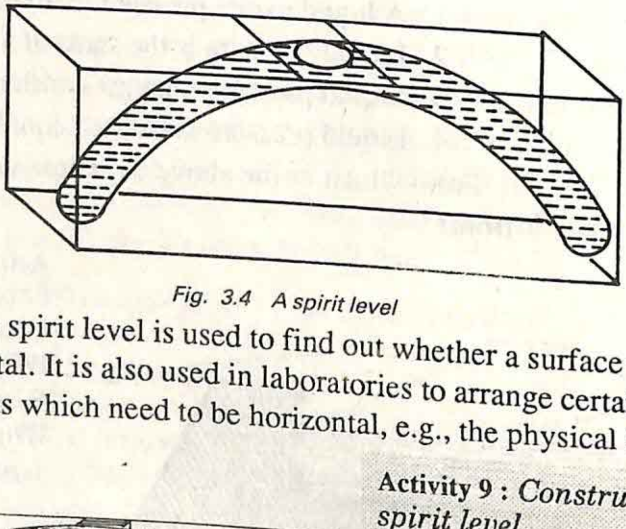
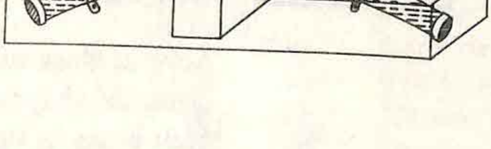


Fig. 3.4 A spirit level

Uses : The spirit level is used to find out whether a surface is inclined or horizontal. It is also used in laboratories to arrange certain instruments which need to be horizontal, e.g., the physical balance.



Activity 9 : *Construct your own spirit level.*

Things needed : A small length of transparent plastic tube of about 5 cms. diameter, some spirit, plasticine, a rectangular box e.g., a toothbrush box.

Method : Seal the tube at one end with plasticine. Fill it almost completely, with spirit. Just leave a little air gap for the bubble. Seal the other end too. Arrange the tube in the box as shown. Place the box on a horizontal (level) surface and mark two lines on either side of the bubble.

3.4 Floating

Activity 10 *: Collect items and drop them into a bucket of water. You could use a block of wood, a piece of glass, an empty bottle, a steel plate, a tumbler, a steel table knife, a cork, etc. Which of them sink? Can you give reasons for what happens?*

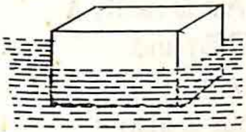
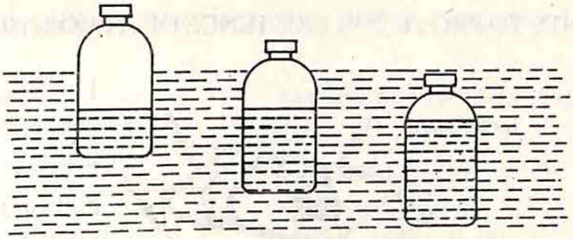


Fig. 3.5 How things float

Things float in water or any other liquid because the water/liquid pushes them up or exerts a pressure from below. Therefore, a block of wood floats, if the water pushes it up with a force equal to the weight of the block which acts downwards (i.e., the gravitational force of the earth which pulls the block downwards).

What happens if the earth pulls it down more than the water pushes it up?



Activity 11 *: Weigh an empty bottle and its cap. Fill a little water in it till it floats vertically. You will see that the water pushes it upwards as much as the earth pulls it downwards. How much is the upward force of the water?*

Add water until the bottle just floats. Now weigh the bottle. What is the upward force when it is floating? What will happen if you add more water to the bottle?

Now try to explain why some objects sink and some seemingly heavy objects float.

Ships made of steel are just like steel plates. They displace a large amount of water so that the upward force of water is large. The more cargo a ship takes on, the deeper it sinks in water. Hence, a line is drawn on the side of the ship. called the *plimsoll line* below which it should not be submerged. This is done for the safety of the ship.

3.5 Atmosphere

ATMOSPHERIC PRESSURE

The earth is surrounded by a vast space filled with air. Air is present over the surface of the earth upto a height of several hundred kilometres. This great sea of air is called the atmosphere. Air is really a mixture of gases, consisting of oxygen (21%), nitrogen (77%) and argon (1%). The remaining 1% consists of traces of ammonia, carbon dioxide, helium and other gases. Some water vapour is also present. The weight of this sea of air pressing upon the earth is called the *atmospheric-pressure.*

It is a well known fact that all living beings need oxygen from the air for breathing. Hence, air is very important for the continuation of life on earth.

Two important properties of air are;

1. air exerts pressure.
2. air has weight.

EXPERIMENTS TO PROVE THE EXISTENCE OF ATMOSPHERIC PRESSURE

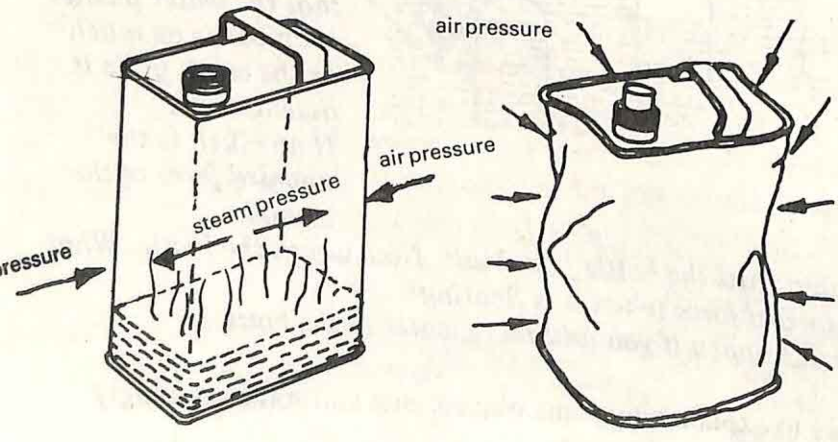


Fig. 3.6 Collapsing can experiment

1. *Collapsing can experiment (Fig.3.6):* Find an empty petrol can or any tin with a lid. Make sure that not a drop of petrol is left in it. Remove the stopper and pour in half a cup of water. Set the can over a stove and heat the water for several minutes. When the water in the can boils, the steam formed drives out most of the air from

the inside of the can. Replace the stopper and allow the can to cool. As the steam cools it changes to water and a partial vacuum is formed within. The small amount of air in the can exerts a very small pressure on the sides of the tin which is no match for the atmospheric pressure working from the outside. Finally, with creaks and groans, the can begins to crumble, (Fig. 3.6) as if some invisible giant was crushing it.

2. *Tumbler experiment (Fig. 3.7)* : Fill a glass tumbler with water up to the brim and cover it with a thick sheet of paper. Keeping the paper in position with one hand, invert the tumbler and withdraw the hand supporting the paper. It will be seen that the paper does not fall even though the weight of the water is acting downwards. This is because the atmospheric pressure acting upwards holds the paper in position and is greater than the weight of the water acting downwards.

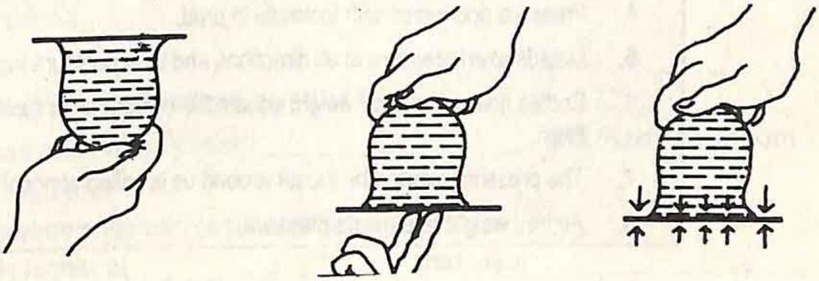
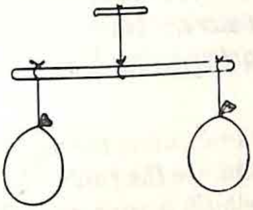
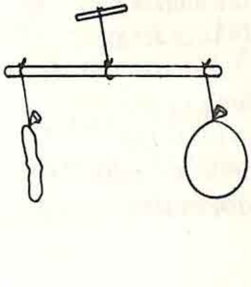


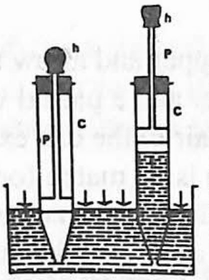
Fig. 3.7 Atmospheric pressure holds the paper up



Activity 12 : *Here is a simple experiment for you to do.*
Suspend a ruler at its center with a piece of thread. Blow up both the balloons to almost equal size and suspend them from either side of the scale so that the beam is horizontal.
Now pierce once of the balloons with a pin. What happens? Why? What conclusion can you draw?



Activity 13 : *Suck some water up into a straw. Cover the end of the straw which is in your mouth with your finger and remove the other end from the water.*
What do you find? Why does the water not trickle out?



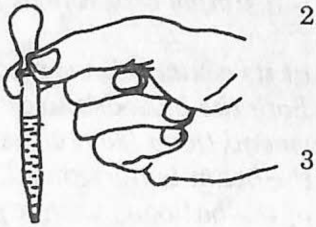
Activity 14 : *Find an old plastic syringe (e.g. an injection syringe). Dip the nozzle into a liquid and raise the piston. What happens? Why?*
When the nozzle is taken out of the liquid, does the liquid spill out? Why?

Basic concepts :

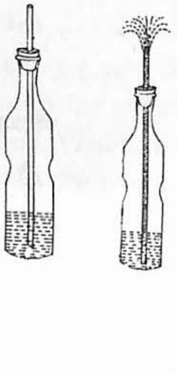
1. Density is the mass of unit volume of a substance.
2. Density is measured in either gm per c.c. or in kg per meter^3.
3. Thrust is the force acting normal to a surface and thrust per unit area is pressure.
4. Pressure decreases with increase in area.
5. Liquids exert pressure in all directions and thus pressure increases with depth.
6. Bodies float when their weight equals the upward force (upthrust) of the liquid on them.
7. The pressure exerted by the air around us is called atmospheric pressure.
8. Air has weight and exerts pressure.

SOME INVESTIGATORY PROJECTS / ACTIVITIES

1. *Is there a water tank on the roof of your house? How is the water stored?* Why *should the water be stored at a high level? How do you get water when you open your taps? Draw a rough sketch to show how water reaches various parts of your home.*

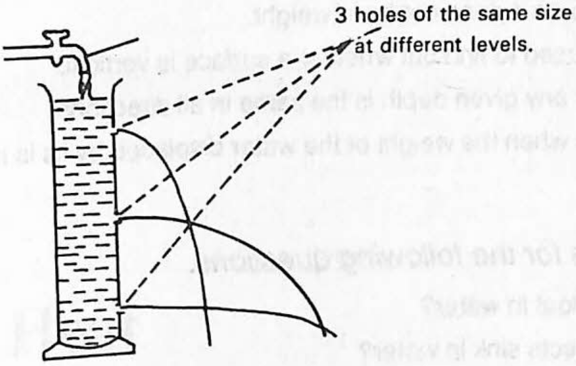


2. *Find out from where your town or city gets its water. Where is it stored? How does it reach you? Try to make a chart showing how your town supplies water?*
3. *Take an ink filler and insert the nozzle in a cup of coloured water. Squeeze the rubber bulb. What happens when the bulb is squeezed? Release the bulb. What happens? Why?*
4. *Make a fountain:*
   Things needed : A bottle such as a cola-bottle or a flask fitted with a one holed cork, drinking straws, some coloured liquid.
   Method : Set up the apparatus as shown in the diagram. Blow through the straw and close the opening with your fore-fingers. Then remove your finger. You will now have a coloured fountain.



REVISION TIME

I Look at this diagram and complete the following statements:



1. The purpose of this experiments is to show that ____________.
2. The water flows most quickly from ____________ and most slowly from ______________.
3. From this experiment we can conclude that
   a) Pressure is higher at ______________ than near ____________ of the water.
   b) Pressure increases with ____________.

II. *Fill in the blanks :*

1. The force acting perpendicular to a surface is called ____________.
2. Thrust is measured in ______________ in the SI system.
3. Thrust per unit area is called ____________.
4. A balloon filled with water will bulge out because a liquid exerts pressure in ______________.
5. Pressure ______________ with depth.
6. Water ______________ its own level.
7. The spirit level is used to find out whether a surface is ______________.
8. The siphon is used to ______________ a liquid from one vessel to another.
9. Air has ______________ and exerts ______________.

III. *State whether true or false.*

1. Density is measured in grams per metre cubed.
2. Pressure decreases with depth.
3. The weight of 1 c.c. of different substances is not the same.

4. The density of silver is more than the density of gold.
5. Substances with the greatest mass have the lowest density and substances with the lowest mass have the highest density.
6. The siphon cannot work in a vacuum.
7. Air is not felt because it does not have weight.
8. The spirit level is used to find out whether a surface is vertical.
9. Liquid pressure at any given depth is the same in all directions.
10. An iron ship floats when the weight of the water displaced by its is more than its own weight.

IV. *Give short answers for the following questions.*

1. Why does wood float in water?
2. Why do metal objects sink in water?
3. Why do hydrogen balloons rise in air?
4. Why is a dam broader at the base?
5. Define thrust and pressure.
6. What are the uses of the siphon?
7. Why is air not felt?
8. What does the collapsing can experiment demonstrate?

V *Answer the following questions:*

1. What are the characteristics of liquid pressure?
2. Describe two experiments to show that air exerts pressure.
3. A block of iron has a volume of 30 c.c. and a mass of 284 gm. Calculate its density. (Ans : 9.47 gm/cc)
4. A cube of lead of side 4 cm has a weight of .730 kg. Calculate its density. (Ans: 11.4 gm/cc)
5. Find the density of a sphere of mass 300 gm and a volume of 50 cc. (Ans: 6 gm/cc)
6. Describe two applications of atmospheric pressure.
7. A block of a certain material has the following dimensions.

   length = 2 metres
   breadth = 1 metre
   height = 0.5 metre
   density = 950 kg/m^3
   Calculate the mass of the block. (Ans: Mass = 950 kg)
8. How will you prove that air has weight?

4 Heat

Sources of heat - the sun - fuels - friction - effects of heat - change in dimension - change of state - change of temperature - change in biological and chemical properties - uses - fire protection - extinguishers.

4.1 Sources of heat

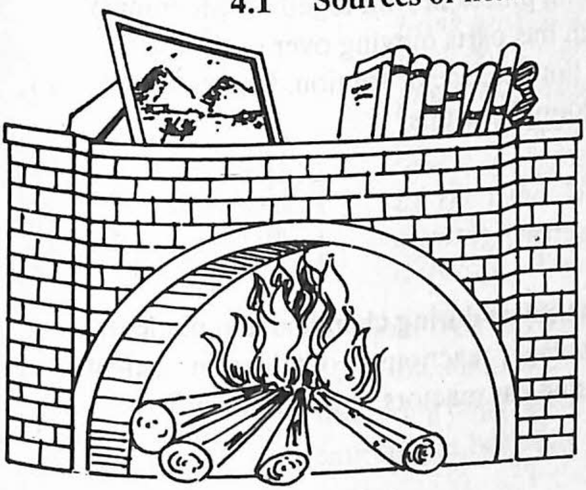


Fig. 4.1 A source of heat

You have been familiar with heat and its effects right from childhood. You know that you get warm when you are close to a burning fire or a heater. You feel cool or cold when you enter an air-conditioned room. So heat or cold is something you cannot see but you feel its effects. You've learnt in chapter 1 that heat is a form of energy. When a body receives heat energy it becomes hot and when it gives away heat it becomes cold. Let us see what are the different sources of heat energy.

1. THE SUN

As you know, the sun is our main source of heat energy. Can you name a few ways in which the heat energy of the sun is useful to us?

Name an appliance which uses the heat energy of the sun to cook food.

2. FUELS

If you take a look at different societies in our country you will find such a variety in the different methods used to provide heat for cooking. Anything which can be burned to provide heat is called a fuel. The cheapest form of fuel is dried cowdung.

Activity 1 : *Name six types of fuel that can be used in homes for cooking?*

1. __________ *2.* __________

3. __________ *4.* __________

5. __________ *6.* __________.

Draw or collect pictures showing each type of fuel.

3. FRICTION

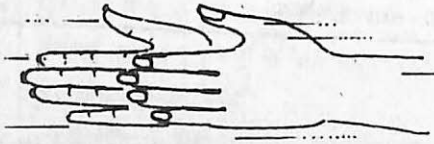


Fig. 4.2 Rubbing causes friction

Rubbing things together produces heat energy. When you rub your hands together you feel warm. You may have already learnt how early men produced fire by rubbing pieces of flint together. Machinery which has parts moving over each other gets hot because of friction. Can you give an example of this?

4. CHEMICAL AND NUCLEAR REACTIONS

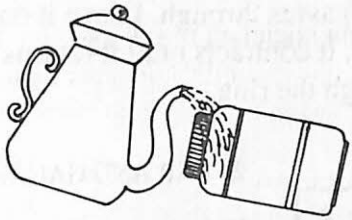
Heat is produced in enormous quantities during chemical and nuclear reactions. The heat produced in nuclear reactions is obtained in nuclear reactors. Have you heard of any nuclear reactors in our country?

4.2 Effects of heat

Heating a substance may cause it to change in dimension, temperature, chemical and biological properties, etc.

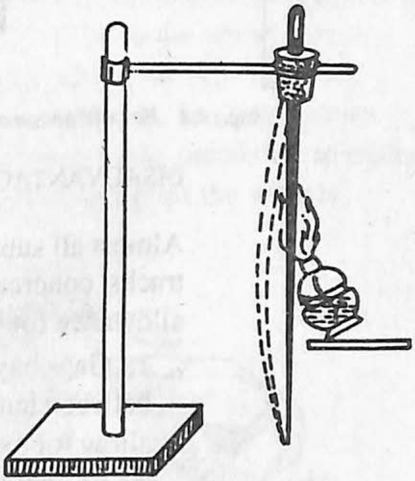
1. CHANGE IN DIMENSION

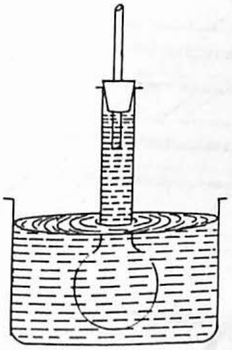
Almost all substances i.e., solids, liquids and gases expand (increase in size) on heating and contract (decrease in size) on cooling.



Activity 2 : *Take a bottle with the metal cap screwed on very tightly so that it is difficult to open it. Now pour some hot water on the cap and try to open the bottle. You will find that it opens easily this time. Why? does this happen?*

Activity 3 : *Fix a knitting needle with one end on the base of a clamp stand and the other end pushed firmly into a cork, held tightly by a clamp (as shown in the figure). Heat the needle along its length with a spirit lamp. The needle expands. Since it is not free to move at either end, it bulges out in the middle. If you take away the source of heat it will go back to its original position. What does this prove?*





Activity 4 : *Take a glass flask and completely fill it with coloured water. Fit a one-holed stopper and glass tube in its mouth so that a little liquid is forced up the tube. Mark the level of water in the tube with a gummed paper. Immerse the flask in hot water contained in a trough. What happens? Why?*

Apart from the above experiments there are a few other well known experiments to show that solids expand on heating. Read through the following experiments and see whether you can do any similar experiment based on them.

1. BALL AND RING EXPERIMENT

Take the apparatus known as Gravesand's ball and ring (Fig. 4.3). The ball just passes through the ring at ordinary temperature, i.e., when the ball is cold. Heat the ball over a bunsen flame for a few minutes and

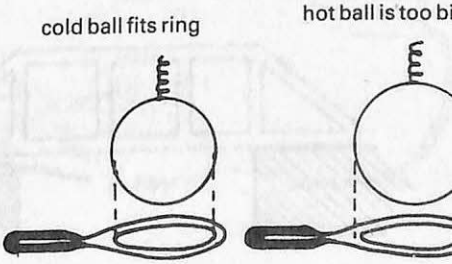


Fig. 4.3 Gravesand's ball and ring

try to pass it through the ring. You will find that since the ball has gained in size, it no longer passes through. Leave it on the ring and allow it to cool. As it cools, it contracts until it returns to its original size, and then passes through the ring.

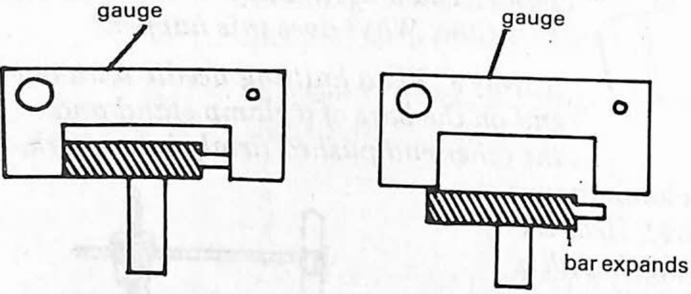


Fig. 4.4 Bar and gauge experiment

2. BAR AND GAUGE EXPERIMENT

This apparatus consists of a metal bar and gauge (Fig. 4.4). The gauge slips over the cold bar, but when the bar is heated, it becomes too big to fit into the gauge.

DISADVANTAGES CAUSED BY EXPANSION OF SOLIDS DUE TO HEATING

Almost all substances expand when heated. Hence while laying railway tracks, concrete buildings, bridges etc., care should be taken to make allowance for this expansion.

1. Gaps have to be left between lengths of rail to allow for expansion (Fig. 4.5). Otherwise the rails would bend. The 'fish plates' connecting 2 lengths of rail have oval holes which allow for expansion.
2. Allowance for expansion has to be made in the steel parts of concrete buildings and in the steel girders used in bridges. Otherwise they would bend and cause damage to the structures. Roofs of buildings made of steel girders should also be modified. One end of the steel girders are made to rest on rollers and special joints that allow for expansion (Fig.4.6).
3. Damage due to expansion of hot-water pipes is prevented by using

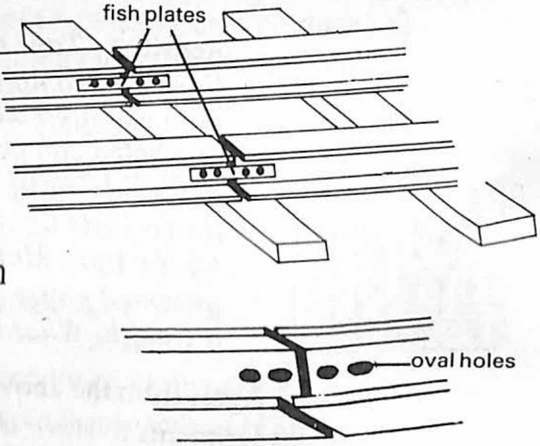


Fig. 4.5 Gaps left between rails

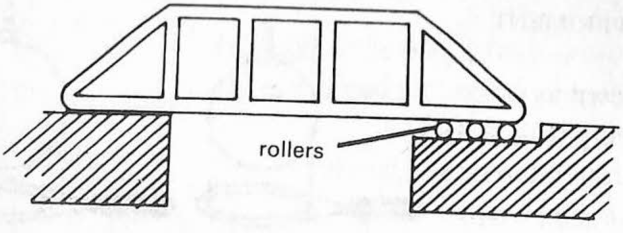


Fig. 4.6 Steel girders resting on rollers

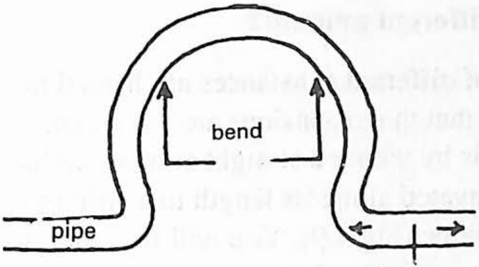


Fig. 4.7 Bends in pipes

loops or bends in the pipes (Fig.4.7). The bent portion is usually made of lead which is a softer metal and bends easily without breaking.

USEFUL APPLICATIONS OF EXPANSION

Expansion can also be useful to us. You have already seen how we can open tight metal caps using our knowledge of expansion.

You may have noticed that the wheels of a bullock-cart have iron tyres. The wheelwright, who fixes these tyres on to the wheel, first makes the tyre just a little too small for the wheel. He then heats the tyre to make it expand, and while the tyre is still hot, he slips it on to the wheel. He next throws buckets of water on to the metal tyre to make it cool quickly. As the tyre cools, it contracts and grips the wheels firmly (Fig.4.8).

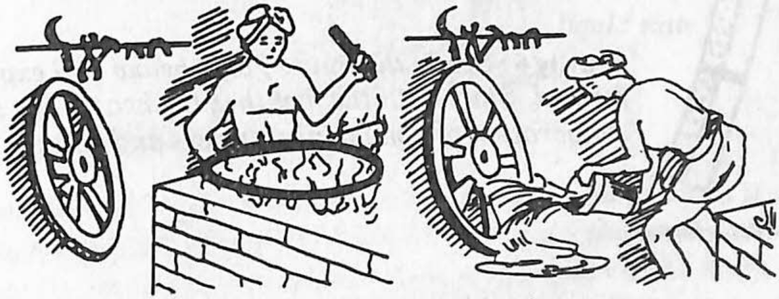
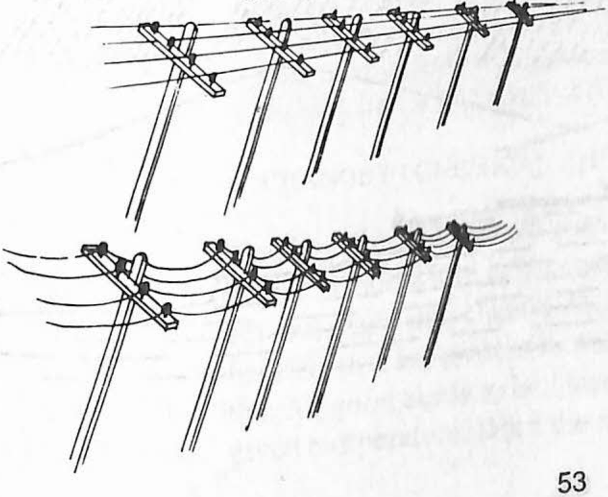
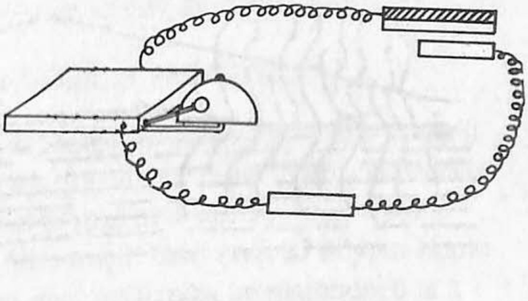


Fig. 4.8 A wheelwright at work

Activity 5: *Can you tell from the diagrams below how our knowledge of expansion is made use of?*





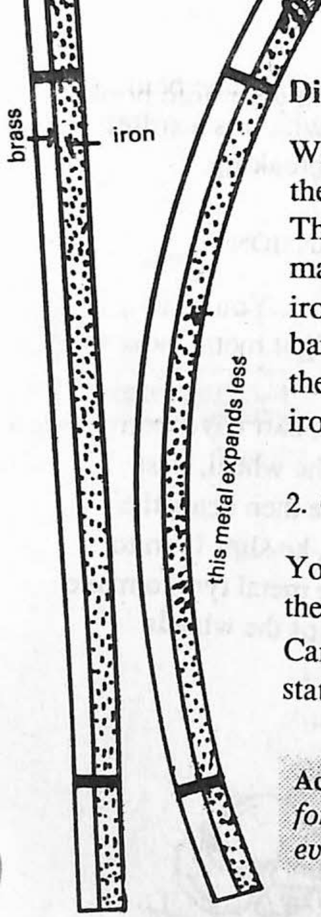


Fig. 4.9 A bimetallic strip

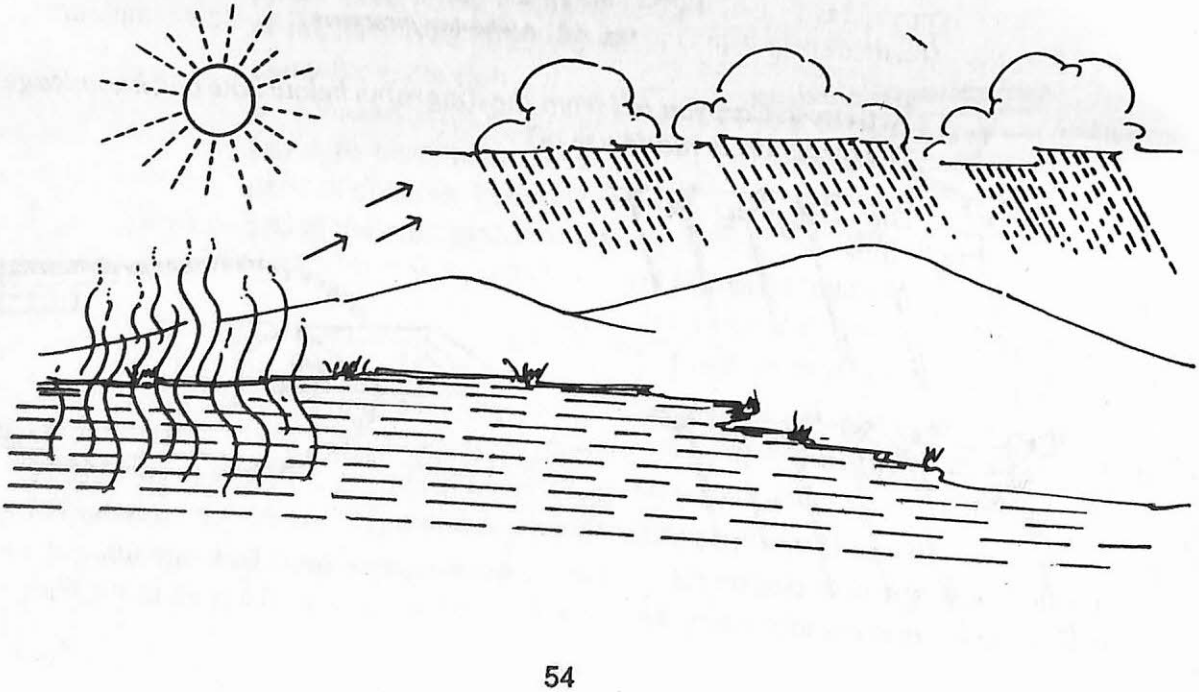
Different substances expand by different amounts

When rods of the same length but of different substances are heated to the same extent, experiments show that the expansions are not equal. This can be shown, in case of metals by taking a straight compound bar made up of a strip of brass firmly reveted along its length to a strip of iron, and heating it over a bunsen flame (Fig.4.9). You will find that the bar becomes curved after a few minutes in the flame. Since brass is on the outside of the curve, it is evident that it has expanded more than the iron.

2. CHANGE OF STATE

You already know that matter exists in three forms or 'states'. They are the *solid state*, the *liquid state* and the *gaseous state*.
Can you name the most common substance which exists in all the three states? How does it change from one state to the other?

Activity 6 : *Study the figure given below and explain how rain is formed. Start with the fact that the heat of the sun causes evaporation of ponds, lakes, rivers and oceans.*



(Fig. 4.10) shows the three states of water. Draw it in your note book.

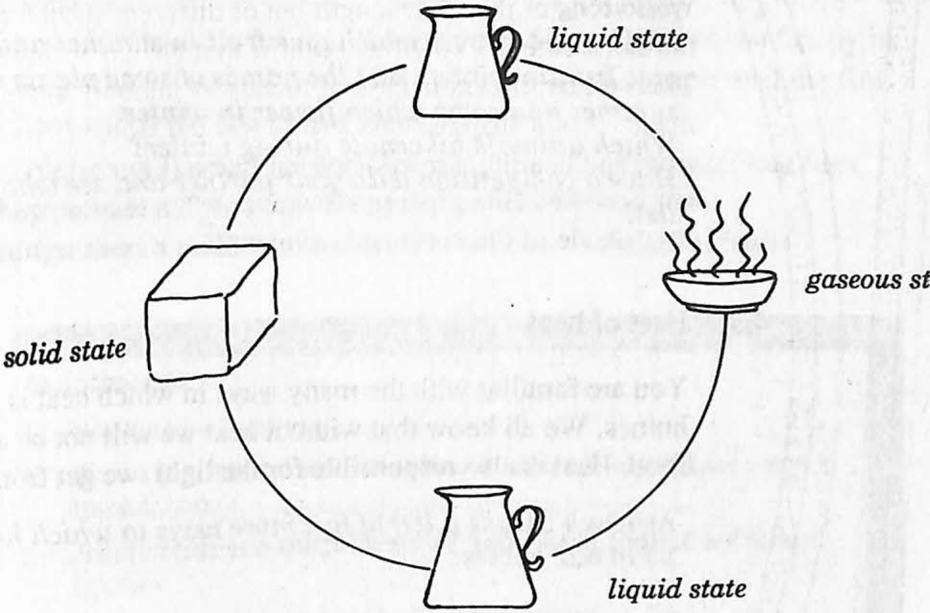


Fig. 4.10 States of matter

3. CHANGE OF TEMPERATURE

We have already seen that it is our sense of touch which tells us if a body is hot or cold. Touching a body gives us only an idea of how hot or cold it is, i.e., it gives us an idea of the *temperature* of the body. Temperature is the degree of hotness of a body. How do we measure temperature?

Activity 7 : *Questions to think about :*
Have you seen a thermometer? Have you ever used one?
On what principle does it work?
How many different types of thermometers have you seen?
Make a list of the ways a thermometer can be useful.

4. CHANGE IN CHEMICAL AND BIOLOGICAL PROPERTIES

You have seen that there is an acid present in sour milk which make it curdle. Thick white curds rise to the top of sour milk. This is skimmed off and made into cheese. The acid in sour milk comes from certain bacteria that are present in milk. You might have noticed in your home that for good curds to be made the sour milk must be maintained at a given temperature. Does the curd set if you keep the milk in the fridge?

Activity 8 : *Temperature affects nature too. Find answers for the following :*
Make a list of trees which give fruit in summer and those which give fruit in winter. List the names of some plants which flower in summer and some which flower in winter.
Which animals hibernate during winter?
Have a competition with your partner and see who makes a longer list!

4.3 Uses of heat

You are familiar with the many ways in which heat is used in our homes. We all know that without heat we will not be able to cook our food. Heat is also responsible for the light we get from electric bulbs.

Activity 9 : *Make a list of five more ways in which heat is useful to us in our homes.*

FIRE PROTECTION

Even though fire is of immense use to man, it can also be a dangerous enemy. We should know what to do if there is a fire in our home, school or work place. Carelessness with matches and cigarette stubs is one of the chief causes of fire. Fires are also caused by electrical faults.

Small fires can be extinguished (put out) by throwing sand and buckets of water over it. Woollen blankets do not easily catch fire and can be used to put out the fire. If a person's clothes have caught fire, wrap him up in a blanket. This will cut out the supply of air and help to put out the fire.

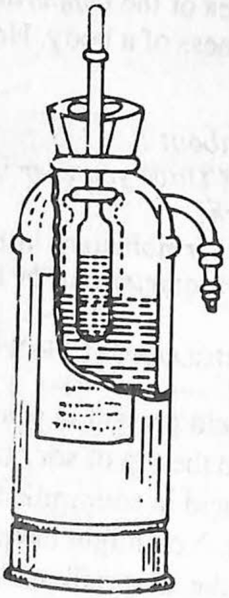


Fig. 4.11 A fire extinguisher

FIRE EXTINGUSHERS

In most buildings and public places, it is essential to have fire extinguishers. A fire extinguisher helps to put out a fire by lowering the temperature and cutting off the oxygen supply.

Most fire extinguishers consist of a metal container filled with water and chemicals. A common extinguisher is the soda-acid type which sprays water and carbon dioxide onto fires (Fig. 4.11). Here it is mainly the water which extinguishes the fire by its cooling effect. The carbon dioxide helps to cut off oxygen over the fire without which the fire cannot continue burning.

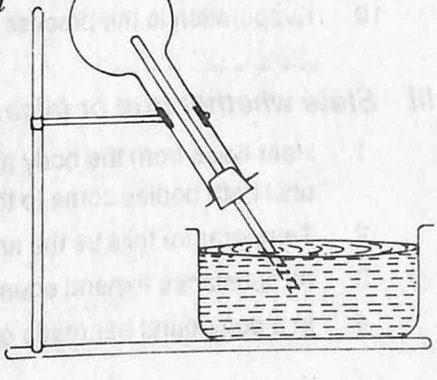
Foam extinguishers are used for dealing with oil and gasoline fires. They provide a light sticky foam that covers the oil. Water extinguishers should not be used for fires due to electrical faults.

Basic concepts

1. Heat is a form of energy.
2. When a body receives heat energy it becomes hot and when it loses energy it becomes cold.
3. The main sources of energy are the sun, fuels, friction, chemical and nuclear reactions.
4. Substances expand on heating and contract on cooling.
5. Matter exists in three states-solids, liquids and gases.
6. Temperature is the degree of hotness or coldness of a body.
7. We measure temperature with a thermometer.
8. Heat causes change in chemical and biological properties.
9. Heat is useful to us in our homes.
10. Fire extinguishers lower the temperature and cut off the oxygen supply over the fire.

SOME INVESTEGATORY PROJECTS / ACTIVITIES

1. *Invert a glass flask over a trough of coloured water as shown. Slightly warm the flask with a spirit lamp. (You may need some one to help you with this.) What do you notice? What do you see near the open end of the glass tube? Why? Now allow the flask to cool by wrapping a cold, damp towel*



around it. What happens to the liquid level in the tube now? Why?

2. *If you are able to get a thermometer either in your school laboratory or at home, find the temperature of some ice cubes, the temperature of boiling water, the temperature of steam, the room temperature, and the temperature in the sunlight.*

3. *Collect pictures and make a chart to show the uses of heat. Mention how it is used in the various fields of industry, transport, etc.*

REVISION TIME

I Fill in the blanks:

1. Heat is a form of __________.
2. Temperature tells us how __________ or __________ a body is.
3. A thermometer measures the __________.
4. Thermometers make use of the fact that all substances __________ when they are heated and __________.
5. Liquids expand more than __________ and __________ expand more than liquids.
6. When two bodies of different temperature touch one another, heat flows from the body at a __________ temperature to the body at a __________ temperature. Heat will continue to flow until the two bodies are at the __________ temperature.
7. The main source of heat energy is the __________.
8. Matter may exist as a __________ a __________ or __________. It is possible to change one form into another.
9. The change of a solid to a liquid is called __________.
10. Evaporation is the process during which a __________ is changed to a __________.

II State whether true or false.

1. Heat flows from the body at a higher temperature to the body at a lower temperature until both bodies come to the same temperature.
2. Temperature tells us the amount of heat contained in a substance.
3. All substaces expand equally.
4. In a compound bar made of brass of brass and iron, iron expands more than brass.

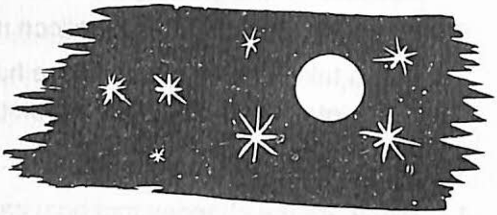
5. All gases expand to the same extent when heated.
6. The density of hot air in a balloon is more than that of the atmosphere.
7. If you take a metal spoon in one hand and a wooden ruler in the other and plunge thei ends into hot water, you will soon drop the ruler.

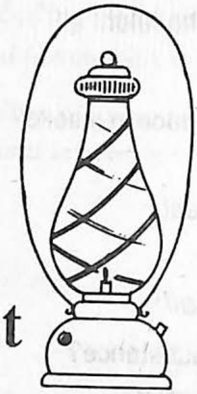
IV Answer the following briefly:

1. What are the changes that heat can produce in a solid?
2. What is meant by the volume of a gas?
3. Distinguish between temperature and heat.
4. Why is a space left between iron rails?

V Answer the following questions in detail:

1. What are the chief effects of heat on a substance?
2. Why does a substance expand when heated?
3. Describe two experiments to show that solids expand when heated.
4. Write a brief note on the three states of matter.
5. Describe an experiment to show that a liquid expands when heated.
6. Describe an experiment to show that a gas expands when heated.
7. Describe a bimetallic strip. How is it used to show that different substances expand by different amounts?
8. How does the knowledge of expansions help us?

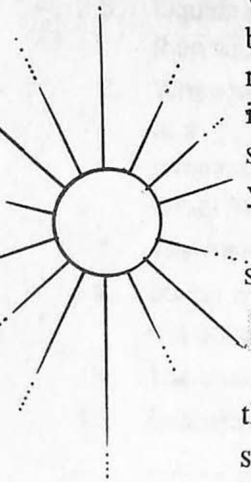




5 Light

Sources of light - natural sources - artificial sources - optical media - transparent translucent and opaque media - path of light - rectilinear propagation of light - colours of light - dispersion of light - uses of light - laser beams.

5.1 Sources



When you enter a room at night you know that the objects in the room become visible only if you switch on the light or light a candle. This means that it is the light which enables us to see objects. What happens in the day time? We don't have to switch on the light because we have sunlight. Light, which enables us to see objects is a form of energy. Can you name two ways by which we get energy from sunlight?

The sun, the electric light, the candle which provide light for us to see objects are called *sources of light.*

Activity 1 : *Make a list of at least six different sources of light.*

In the list you have made you will have at least one or two sources that give and their own light and do not depend on man for it. Such sources such as the sun, the moon and the stars are *natural sources* of light. Man made sources of light such as the candle, the electric lamp, the oil lamp, etc., are *artificial sources* of light.

Again, among the natural and artificial sources of light energy, some sources give out light energy of their own, i.e., they do not depend on other bodies for their light. They are called *luminous bodies.* Objects which of themselves cannot emit light, but can do so when they receive light from other bodies are *non-luminous bodies.*

Activity 2 : *Pick out the non-luminous object from the list given below :*
burning coal, wick lamp, the sun, a candle, the moon, a fluorescent lamp (tube light), the stars.

Most objects around us are non-luminous.

They become visible only when light from other luminous bodies fall on them and this light is reflected to our eyes (Fig.5.1).

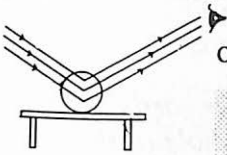


Fig. 5.1 How objects become visible

Activity 3 : *Form groups and collect pictures to make a chart under the following headings.*

Sources of light

Luminous	Non-luminous
Natural	Artificial

5.2 Optical media

Activity 4 : *Light a candle or a lamp and place it on a table. View the lighted candle through a piece of plane glass, a piece of cellophane paper and a page of plain white paper.*
After viewing through the plain white paper smear a corner of it with oil and again view the candle through it. Note down the following :
Which material allows the most light to come through? Can you see the flame through it? Which material allows only some light to come through? Can you see the flame through them? Which material block out all the light from reaching you?

transparent

translucent

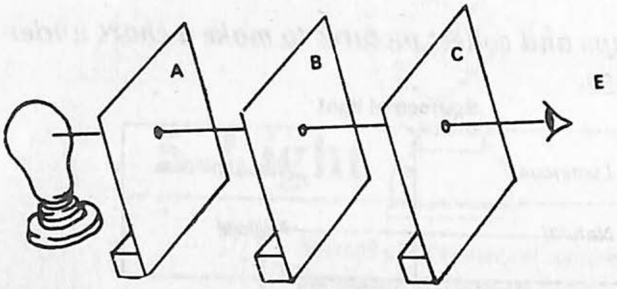
opaque.

Fig. 5.2 The different optical media

Any substance through which light can pass is called an *optical medium.* A substance through which light can be transmitted and through which objects can be seen is called a *transparent medium.* A substance through which light cannot pass is said to be *opaque.* Water and glass are transparent while wood, stone and metals are opaque. A substance which allows only a small fraction of the light to pass through it and through which distinct vision is not possible is said to be *translucent* (Fig. 5.2). Wax, oiled paper, ground glass and opal or milk glass are examples of translucent substances.

5.3 Path of light

Have you ever observed a beam of sunlight shining through a window into a room. The innumerable dust particles in the path of the light become visible and the path of the light appears to be in straight lines. This property of light to travel in straight lines in a medium is called the rectilinear propagation of light.



Activity 5 : *Take three cards A, B, C, each with a fine hole in the centre, and arrange them one behind the other so that the holes are in the same straight line. This can be tested by stretching a fine thread through the holes. Carefully remove the thread without moving any of the cards. Place a source of light at S, behind A, i.e., either a lighted candle or electronic light and look from point E, behind C as in the figure. Is the light visible? Now move any one of the cards. Are the holes still in a straight line? Is the light still visible? What does this experiment show?*

SHADOWS

When light falls on opaque objects shadows are formed They are formed because light travels in straight lines. (Fig. 5.3).

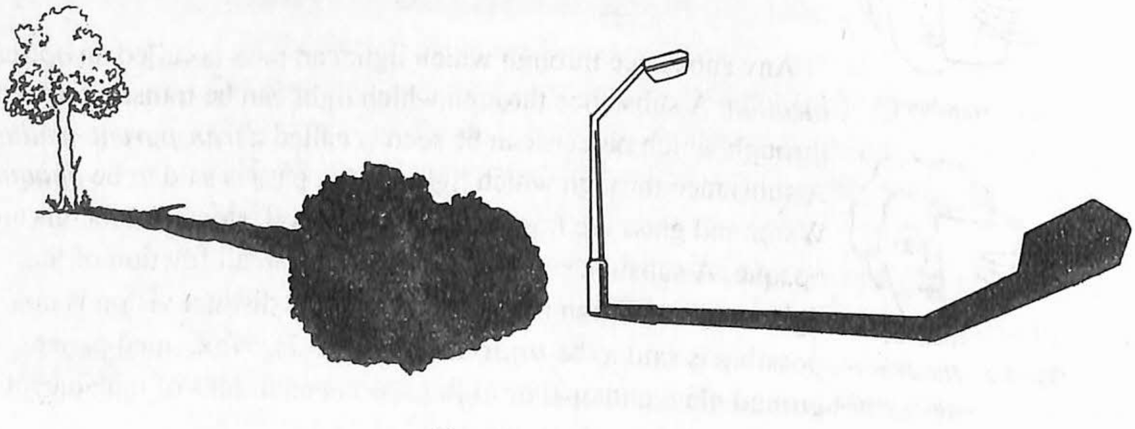
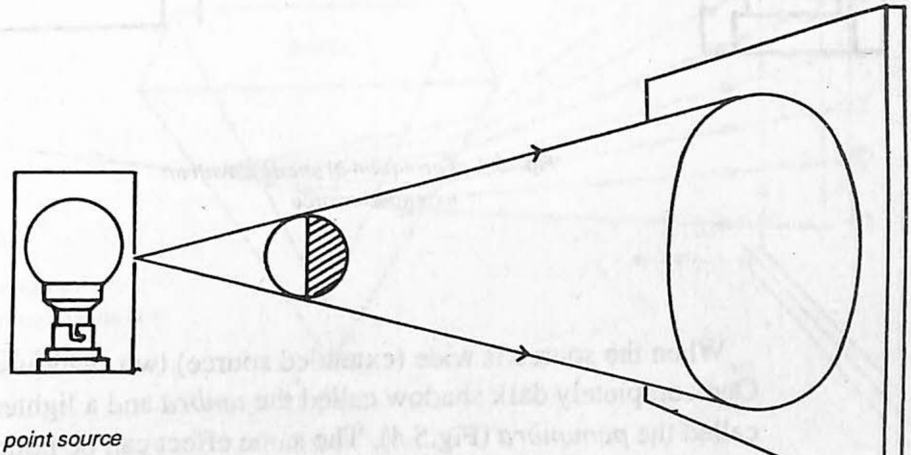
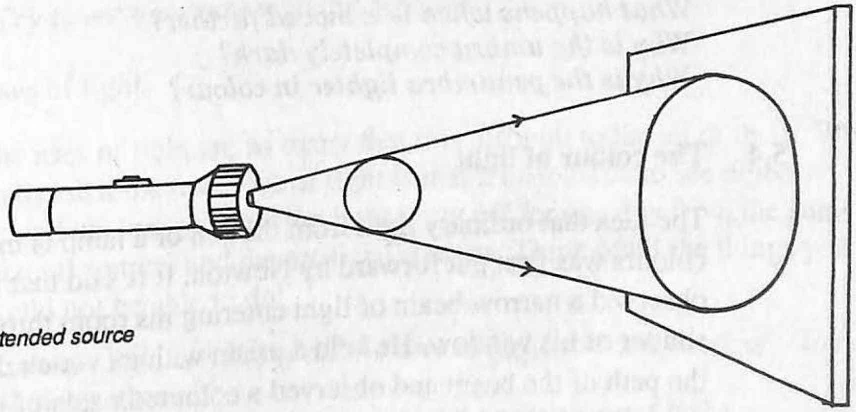


Fig. 5.3 Shadows being formed

Activity 6 : *Place a bulb inside a cardboard box which has a tiny hole in one place. Place the box in front of a wall so that the opening faces the wall. Now place objects like a ball, rubber, pencil box, etc., between the wall and the source of light. Observe the shadows that are formed. What happens when you alter the distance between the object and the source? Repeat the experiment with a box with a larger hole. Observe the difference.*
A torch with the front glass covered by a cardboard with a small hole as shown in figure can be used instead of the bulb.
To get an extended source remove the cardboard from the face of the torch.





If the source of light is very small i.e., a point source, a sharp well defined shadow will be formed on the screen.

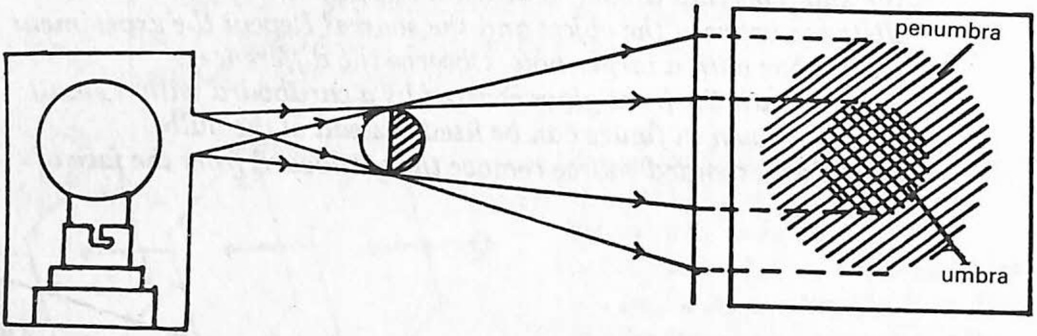


Fig. 5.4 Formation of shadow with an extended source

When the source is wide (extended source) two shadows can be seen. One completely dark shadow called the *umbra* and a lighter shadow called the *penumbra* (Fig.5.4). The same effect can be noticed if a torch is used instead of a light ray box.

Activity 7 : *Questions to think about :*
How does the shadow change when the ball (object) is moved closer to the source?
What happens when it is moved further?
Why is the umbra completely dark?
Why is the penumbra lighter in colour?

5.4 The colour of light

The idea that ordinary light from the sun or a lamp is made up of many colours was first put forward by Newton. It is said that Newton observed a narrow beam of light entering his room through a hole in the shutter of his window. He held a prism with its vertex downwards in the path of the beam and observed a coloured patch of light on the wall opposite. Newton gave the name *spectrum* to this coloured patch of light. The *spectrum* was seen to consist of seven colours of light – violet, indigo, blue, green, yellow, orange and red. The splitting up of white light into different colours is called *dispersion of light.* (Fig. 5.5).

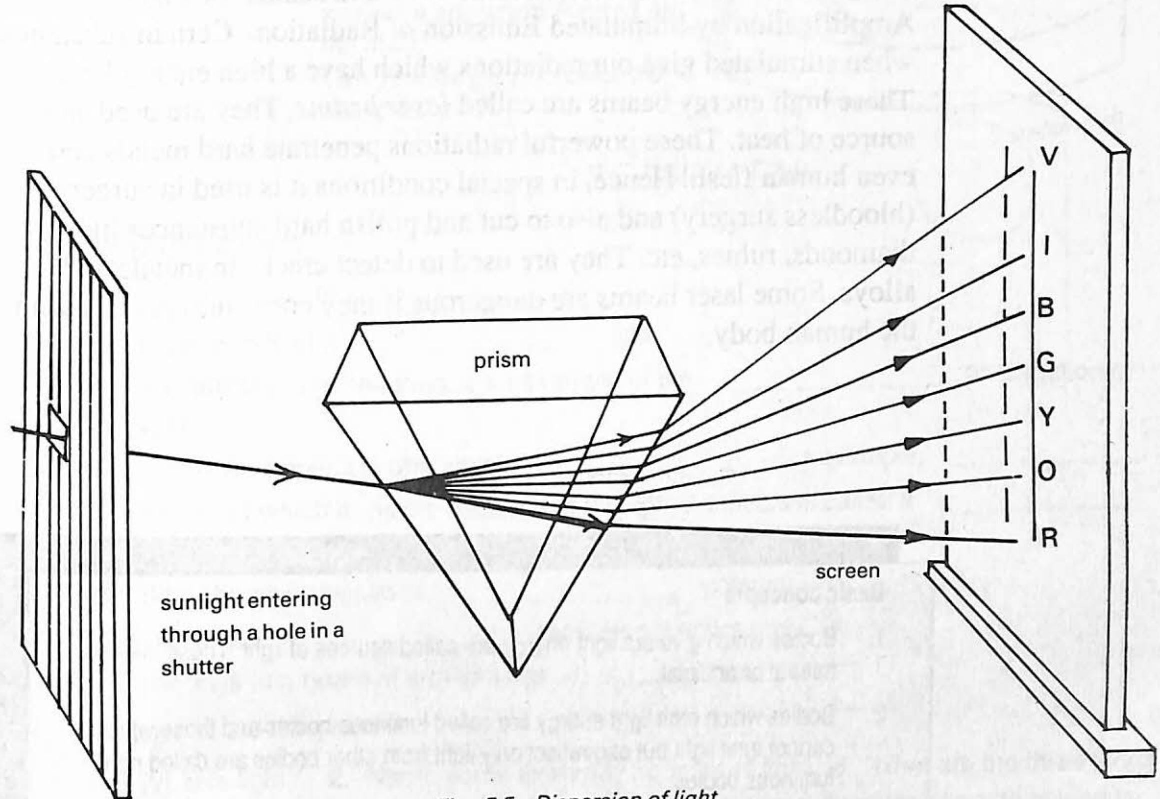


Fig. 5.5 Dispersion of light

Activity 8 : *Draw this figure using colour pencils or sketch pens to show the spectrum.*
Try to see a spectrum using a prism.

5.5 Uses of light

The uses of light are so many that it is difficult to list all of them. We realise that the main use of light is that it enables us to see objects around us. Imagine that the light is cut off for one day from the sun (natural source) and the artificial sources. Think of all the things you would not be able to do!

Activity 9 : *Make a list of all the uses of light you can think of -- list at least ten uses.*
Collect pictures and prepare a chart on the uses of light.

LASER

You may have heard about Lasers which are used in various fields today. Laser was first discovered in 1961 and stands for Light Amplification by Stimulated Emission of Radiation. Certain substances when stimulated give out radiations which have a high energy level. These high energy beams are called *laser beams*. They are used as a source of heat. These powerful radiations penetrate hard metals and even human flesh. Hence, in special conditions it is used in surgery (bloodless surgery) and also to cut and polish hard substances like diamonds, rubies, etc. They are used to detect cracks in metals and alloys. Some laser beams are dangerous if they come into contact with the human body.

Basic concepts

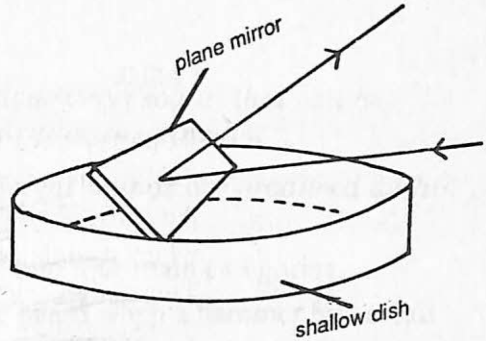
1. Bodies which give out light energy are called sources of light. These may be natural or artificial.
2. Bodies which emit light energy are called luminous bodies and those which cannot emit light but can reflect only light from other bodies are called non-luminous bodies.
3. Any substance through which light can pass is called the optical medium
4. Depending upon the amount of the light that can pass through them, substances may be identified as transparent, translucent or opaque.
5. Light travels in straight lines and casts shadows of objects.
6. Shadows have two regions. The darker region called the umbra and the lighter region called the penumbra.
7. White light breaksup into seven colours when it is dispersed.
8. The seven colours formed is called a spectrum.
9. A very high energy light beam is called a laser beam.

SOME INVESTIGATORY PROJECTS / ACTIVITIES

1. *Collect pictures and prepare a chart on the uses of light.*
2. *Take a shallow dish of water (e.g. a plastic tiffin box) and a small*

strip of plane mirror. Holding the mirror in your hand place it in the water as shown in the figure. Rotate the mirror till you see a spectrum formed on the wall.

Can you see all the colours of the spectrum?



REVISION TIME

I Fill in the blanks:

1. Light is a form of __________.
2. Light travels in a __________ line.
3. The formation of shadows is an example of the __________ propagation of light.
4. A luminous object is one which __________. For example, __________.
5. An object which is visible because of the light it reflects is called a __________ object.
6. Sunlight is composed of __________ colours.
7. The prism __________ them into a spectrum.
8. The rays in a beam of sunlight are __________.

II Answer in a line or two :

1. What is light? 2. Name some everyday sources of light. 3. What are the three kinds of substances? Describe each one. 4. What did Newton discover when he placed a prism in the path of a narrow beam of sunlight? 5. What did Newton conclude from his experiment with the prism?

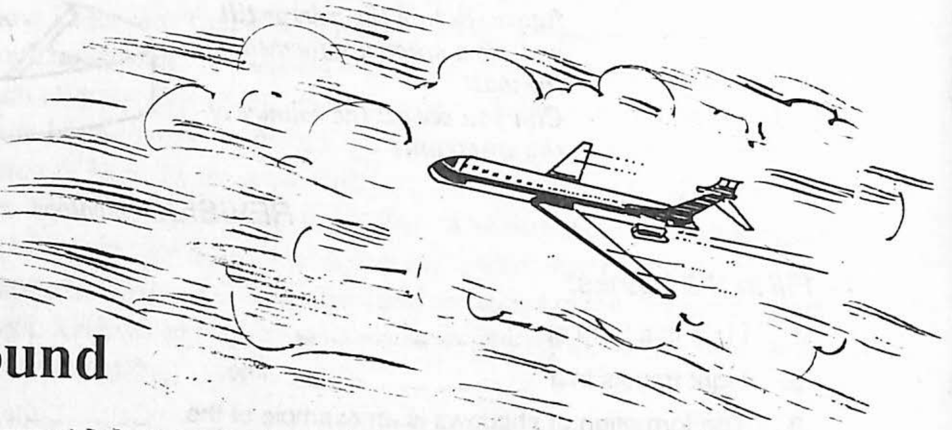
III Complete the following table, giving the properties of the materials.

Materials	transparent	translucent	opaque
water			
dirty water			
steel			
wood			
glass			
wax			

IV Write notes on

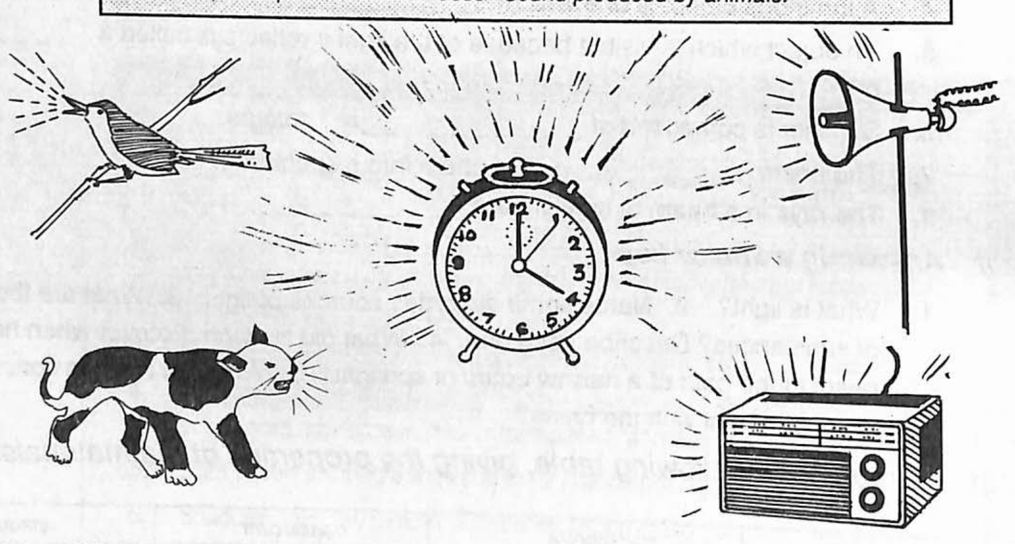
a. Shadows formed by a point source and an extended source of light.

b. Laser beams and its applications.



6 Sound

Making - sound by striking - rubbing - blowing - plucking - types of sound - loud - soft - speed of sound - uses - sound produced by animals.



6.1 Making sound

Be as quiet as you can and listen! Count and identify the different kinds of sounds you can hear. These may be made by people, animals or machines. There are other sounds which nature makes by means of winds and waters. Some are frightening, like those heard in a thunderstorm.

Let us consider a few common sounds. We are all familiar with the buzzing of a bee, the rustling of paper, the whirring of a fan, the rattling of a cart and the tinkling of glass.

Activity 1 : *Make a list of all the various ways sound that can be made. You can include musical instruments in the list.*

Activity 2 : *Try and find how the different sounds are produced with each of the items in above list.*

You will find, sounds generally fall into four main categories.

1. *Striking* : Sounds like these are heard when a hammer hits a nail or a drummer beats a drum. (Fig. 6.1).

2. *Rubbing* : These sounds may be made by a grinding stone, or rustling of leaves, sweeping, etc. (Fig. 6.2).

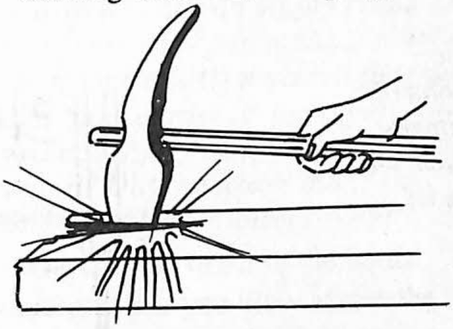


Fig. 6.1 Striking

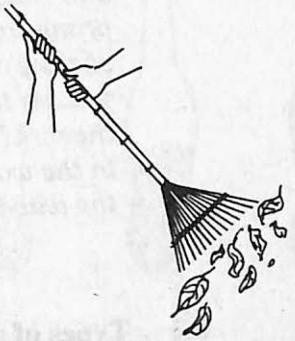


Fig. 6.2 Rubbing

3. *Blowing* : Sounds such as those produced by a trumpet, flute, or mouth organ, or just blowing over a bottle partly filled with water. (Fig. 6.3)

4. *Plucking* : These sounds are made by string instruments such as guitar, veena, sitar, etc. (Fig. 6.4).

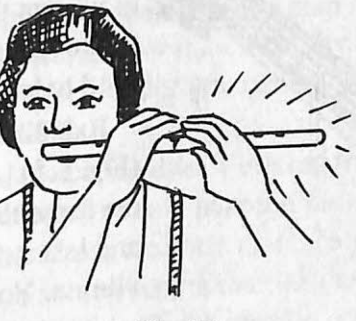


Fig. 6.3 Blowing

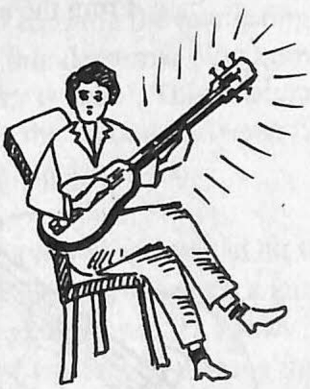
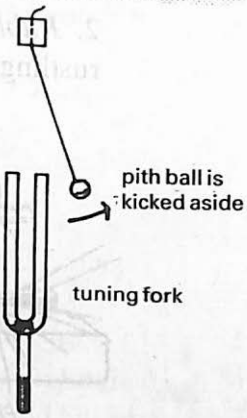


Fig. 6.4 Plucking

All sounds are not pleasant to the human ear. Unpleasant sounds are termed noise.

Now observe carefully and see in as many instances as possible what happens when a body is made to produce sound energy. You will find that all these sounds are caused by some sudden movement or motion. In almost all cases the movement is very fast and we cannot see it. It is a rapid to and fro motion which we call vibration.

Activity 3 : *Suspend a pith ball from a stand. Strike a tuning fork on a rubber pad and bring it close to the suspended ball. What happens? Why?*
Now strike the fork on the rubber pad again and hold it so that the prong touches the surface of water. Can you see the vibrations of the fork? What happens to the water. Can you see the waves set up in it?



6.2 Types of sound

Activity 4 : *Take a steel plate and hit it gently with a spoon. What type of sound do you hear? Is it loud or soft?*
Now hit it hard with the same spoon. Does the sound become louder?

Activity 5 : *Blow gently through a whistle. Then blow hard. What type of sounds do you hear? Why?*

From the above activities you will notice that bodies vibrate giving a *loud* sound, if more force is used to vibrate the body and the sound produced is *soft*, if less force is used to vibrate the body.

Examine a guitar or a violin (Fig. 6.5). Are all the strings of the same thickness? Pluck the first and last string and see how they vibrate. You will find the thick wires vibrate slowly and give out a low sound and the thin wires vibrate *faster* and give out a *higher* sound.

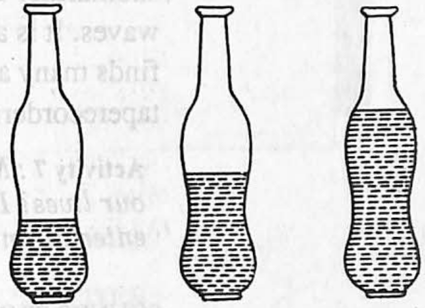
Fig. 6.5 A guitar

Similarly, a higher sound is produced if you tighten the string of the guitar.

In the same guitar or violin pluck one of the string, and try to remember the sound produced. Now press the wire down on to the board at a small distance from the narrow end and again pluck it. How does the sound change? Does the sound become higher or lower?

Thus it can be seen that the pitch of the sound depends on the length, tension and thickness of the string that is plucked.

Activity 6 : *Take an empty bottle and blow over its top to make a sound. Now pour a little water in the bottle and blow across its top again. Do you notice any difference in the sound? Did the water make the sound higher or lower? Why?*



The column of air in the bottle vibrates when you blow across the top of the bottle. The vibrating air makes a sound. When you put water in the bottle you made the air column shorter and so the sound became higher.

6.3 Speed of sound

The speed of light is 3 00,000,000 m/s while the speed of sound is about 330 m/s. You have the opportunity of learning the interesting fact that light travels faster than sound during a thunderstorm. You know that lightning is seen before a clap of thunder is heard. This is because sound travels slower than light. By counting the seconds between lightning and thunder you can easily tell the distance of a thunderstorm.

If you watch a game of cricket from far, you will see the bat hit the ball a little before you hear the knock. Similarly, if you watch a gun being fired from a certain distance you notice that there are a few seconds between seeing the flash and puff of smoke and hearing the sound of the shot. These are two other instances of the fact that sound travels slower than light.

Can you give two other everyday instances to show that light travels faster than sound?

6.4 Uses of sound

Imagine a world without sound! We use sound to communicate with each other. Right from the time we were little babies we used sound to attract the attention of others! Now sound is used in every sphere of our lives — on the roads, in our school, in offices, everywhere.

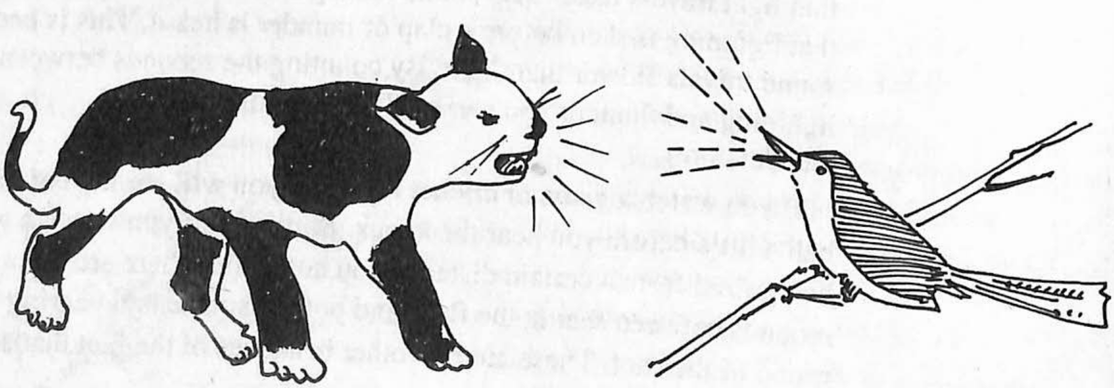
A useful application of sound is SONAR (sound navigation and ranging). This is used to determine the position of an enemy aircraft or submarine. The depth of the sea and ocean can be found using sound waves. It is also used as means of satellite communications. Sound finds many applications in entertainment electronics (like radio, TV, taperecorders, public address systems, etc.).

Activity 7 : *Make a list of how sound is used in the above areas of our lives? Don't forget to mention how sound is used for entertainment!*

SOUNDS PRODUCED BY ANIMALS

You are all familiar with the sounds produced by most animals. But do animals understand each other? Many scientists believe they do. The baby orangutan cries like a human baby when it is hungry. Birds are even better than animals in talking to each other.

Some insects make sounds with different parts of their bodies, the cricket make noises by rubbing the edge of one wing against the other, grasshoppers 'play their violins' by scraping the rough edges of their wings against the upper part of their legs.



Activity 8 : *Name two birds which can imitate the sounds made by man.*

Basic concepts :

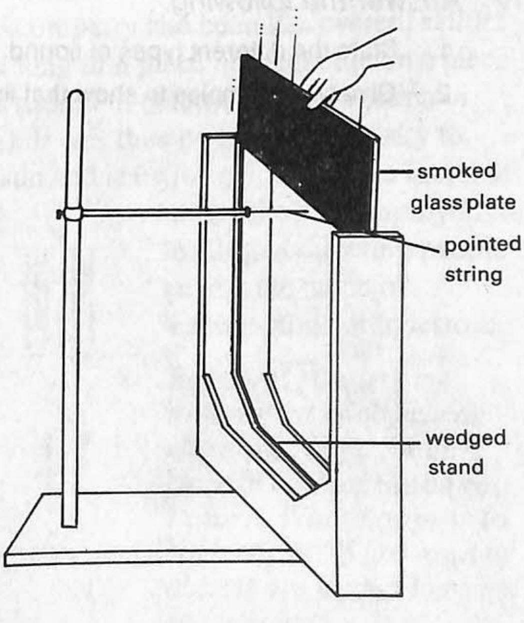
1. Sound can be made in four different ways i.e. striking, rubbing, plucking and blowing.
2. Sound is caused by rapid to and fro motion which we call vibrations.
3. A large force used to vibrate the body produces a loud sound.
4. If the force used is less, then the body vibrates with a soft sound.
5. Bodies which vibrate slowly produce low sound.
6. Bodies which vibrate faster produce higher sounds.
7. The velocity of sound in air is 330 m/s.
8. Light travels faster than sound.

SOME INVESTIGATORY PROJECTS / ACTIVITIES

1. *Form five groups so that there are five to six students in a group. Make musical instruments using coconut shells, strings, china cups, tuning forks, wooden boards, sticks, etc. Have a musical concert using these instruments.*

2. *You know that sound travels in waves. Can you actually see the waves? Clip a fine pointed wire on a stand. Smoke a plane glass plate so that it is uniformly black. You require a wedge-like wooden stand into which the glass plate can be dropped. (See fig.) Place the stand in front of the wire so that the wire just touches the glass plate when it is dropped.*

   Strike a tuning fork on a rubber pad and p;ace it on the wire. Now drop the smoked glass into the wedged stand. Take out the glass plate carefully What do you see? Sound waves!



REVISION TIME

I *Fill in the blanks.*

1. Sound is produced when a body __________.
2. The speed of sound is __________.
3. You see lightning before you hear thunder because __________.
4. Unpleasant sounds are called __________.
5. The four ways in which sound is produced are __________ __________ __________ __________.
6. Weak vibrations produce __________ sound and strong vibrations produce __________ sound.
9. Fast vibrations produce __________ sound.
10. Slow vibrations produce __________ sound.

III *State whether true or false.*

1. Sound travels faster than light.
2. Sound is caused by the vibration of bodies.
3. High sounds are produced by slow vibrations.
4. A shorter wire produces a higher sound.
5. A longer column of air produces a lower sound.

IV *Answer the following.*

1. State the different types of sound. Give at least two examples of each.
2. Give two examples to show that light travels faster than sound.

7. Magnetism

Natural and artificial magnets - shapes of magnets - magnetic force - magnetic force through various substances.

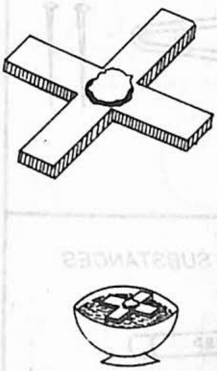
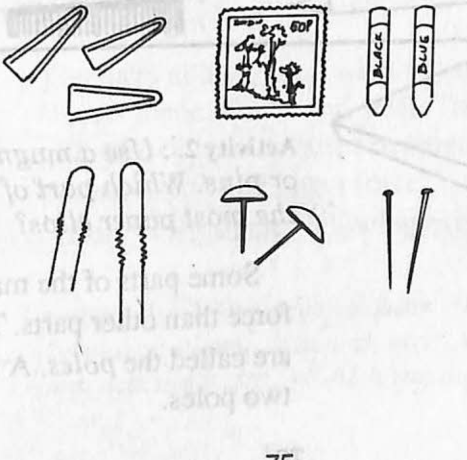


Fig. 7.1 Lodestone

Over 2,000 years ago a certain kind of iron ore was found to have the property of attracting iron and steel and other ores like itself. It was called magnetite after the town of Magnesia in Asia Minor, where it was first discovered. It is generally believed that the Chinese were the first to discover that if a piece of magnetite was suspended by a string so that it could turn around easily in a horizontal plane, one end of it always pointed North. Once this property had been discovered, sailors in European countries floated a long thin piece of magnetite on a piece of wood in a bowl of water and used it to determine the direction in which they had to sail (Fig. 7.1). It was thus no longer necessary to depend on the positions of the sun and stars for guidance. The fact that magnetite was employed for leading or directing people gave it the name of leading-stone or lodestone.



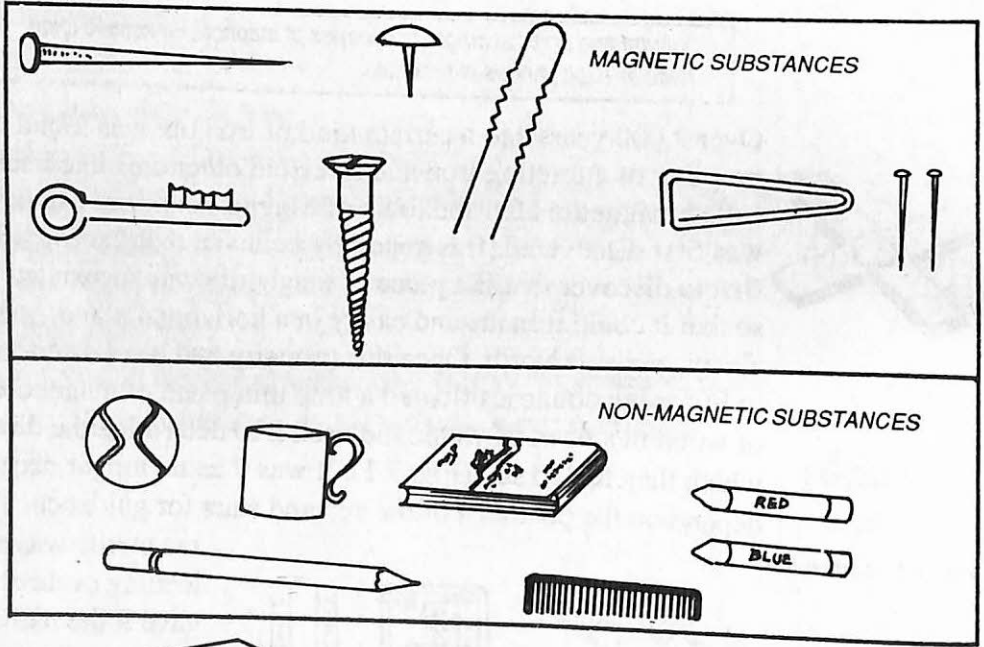
Activity 1. : *Collect an assortment of objects as shown. Bring a magnet close to each of the objects in turn. What happens to each object? What kind of objects are pulled towards the magnet?*

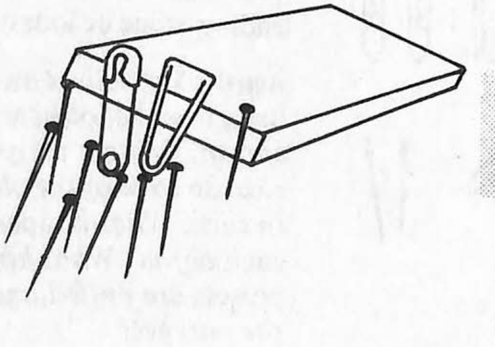
Make a list of the things pulled towards the magnet and those not pulled towards the magnet. Write them in here:

Magnetic substances	Non-magnetic substances
1.	
2.	
3.	
4.	
5.	

Objects that are pulled towards the magnet are *magnetic* and those that are not pulled are non-magnetic.

What do you know about the material which magnetic objects are made of?





Activity 2. : *Use a magnet to lift paper clips or pins. Which part of the magnet pulls the most paper clips?*

Some parts of the magnet have more force than other parts. These stronger parts are called the *poles*. A magnet always has two poles.

7.1. Natural and artificial magnets

There are two types of magnets *natural magnets* and *artificial magnets*. Natural magnets are substances which exhibit the property of magnetism naturally. Substances which can be made to exhibit this property, by various methods are called *artificial magnets*. An artificial magnet may have the following shapes:

1. *Bar magnet* : When the magnet is a rectangular bar, it is called bar magnet (Fig. 7.2).

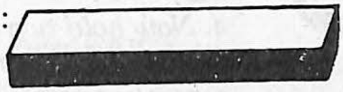


Fig. 7.2 Bar magnet

2. *Horse-shoe magnet* : When it is in the shape of a horse shoe it is called horse-shoe magnet (Fig. 7.3).

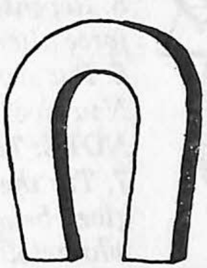


Fig. 7.3 Horse-shoe magnet

3. *Robsons' magnet* : When the magnet is shaped like a dumbbell, it is called Robsons' magnet (Fig. 7.4).

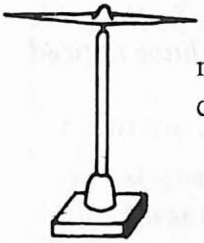


Fig. 7.4 Robson's magnet

4. *Magnetic needle* : A magnet which is shaped like a needle is called magnetic needle (Fig. 7.5).

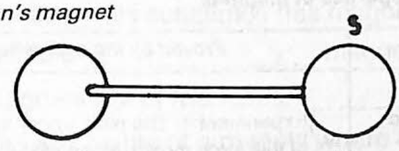
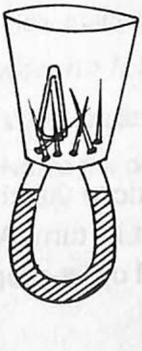


Fig. 7.5 A magnetic needle

MAGNETIC SUBSTANCES

These are substances that can be converted into magnets. Iron, cobalt, nickel and alloys containing these, together with other metals are examples of magnetic substances. The first two substances in this list show strong magnetic powers. Magnets attract only magnetic substances.

7.2. Magnetic force



You have already seen what a magnet can do. It can attract objects made of iron and steel. The pull the magnet exerts on magnetic objects is called magnetic force. Which part of the magnet exerts a stronger force?

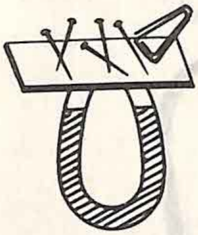
Now perform the following experiments.

Activity 3 : *1.Put several pins and nails into an empty, dry drinking glass. Move a strong horseshoe or bar magnet beneath the glass. What happens to the pin?*

2. Put some pins in a dish of water and hold the magnet near the surface of the water. Does the magnetic force pass through the water?

3. Hold a sheet of paper over the pole of a magnet and bring it near some pins, nails, etc. Does it exert a magnetic force through the paper?

4. Now hold two or more sheets of paper over the magnet and repeat the experiment. Through how many sheets does the magnet continue to exert force?



5. Repeat this with chart paper and then cardboard. Does the force alter?

6. Put several nails on a tin lid and move the magnet beneath it. Now does the magnetic force pass through the lid?

NOTE: Tins are usually made of iron coated with tin.

7. Try the same experiments with other materials too. In the table given below list some properties of magnets which you have noticed while doing the experiments.

Some properties of magnets

Properties	*Proved by the experiments*
1. A magnet exerts a force called magnetic force on magnetic substances.	Experiment 1. The pins, under the influence of this force moves along with the magnet.
2.	
3.	
4.	

While doing these experiments you would have noticed that the pins which are attracted to the magnet attracts other pins in its turn. A pin by itself cannot attract other pins. The magnet has passed on its property to the pins. Magnetism can be 'induced' in non-magnets.

Basic concepts

1. Magnetism makes magnetic objects move.
2. Magnetic objects are made of iron or steel.
3. The lodestone is a natural magnet.
4. Artificial magnets can be obtained in many shapes and sizes.
5. Magnetic force can act through most substances.
6. Magnetic force does not act through magnetic substances.

REVISION TIME

I *Fill in the blanks .*

1. Magnetic attraction was first discovered in an iron ore called __________. It was known to ancient people as the __________ or __________ stone.
2. Because this substance has magnetic properties when it is dug out of the ground, it is called a __________ magnet.
3. Magnets are of two kinds, __________ and __________.
4. The two points of a magnet where the force of attraction is strongest are called the __________ of a magnet.
5. Each magnet has __________ poles.

II *Answer the following :*

1. How do magnets move things?
2. What kind of things do magnets pull?
3. What parts of a magnet are strongest?
4. How many poles does a magnet have?

III. *Answer the following in detail.*

1. What are the properties of magnets.
2. Name the different types of magnets found in the laboratory and draw each of them.

8. Electricity

Uses - electric cell, circuit - conductors and non conductors - heating and lighting effect - electrical appliances.

8.1. Uses

We live in a world where it seems impossible to manage without electricity. We have become used to pressing a switch on the wall to light up a room, or turning on a fan or a radio. Can you try and count the number of ways in which electricity is used today? Our cars carry accumulator batteries for their head lights, and our torches, transistor radios, and calculators have small batteries in them called dry batteries or torch cells. All these make use of what we call 'electric current' which is a form of energy (electrical energy).

Given above are only a few examples of how electricity is useful to us. We can't see the electric energy in any of the above appliances. But we can see the effect it produces. For example, when we switch on the electric light we can only see the light because the electrical energy has been converted into light energy. If you touch the electric bulb you will find it hot, i.e., heat energy is also produced. In fact, the electric current heats the filament of the bulb and it becomes white hot and begins to glow. In the fan the electric energy is converted to mechanical energy.

Activity 1 : *In the tabular column below list the various uses of electricity. Find out what kind of energy it is converted to in each case. Write down your list below:*

Uses of electricity

Where	*How (use)*	*What it does*	*Type of energy it is converted into*
At home	1. Pump set 2. 3. 4.	Pumps water to over heads tank	Mechanical Energy.
On the road	1. 2. 3. 4.		
At school	1. 2. 3. 4.		
In hospitals	1. 2. 3. 4.		
In industry	1. 2. 3. 4.		

Activity 2 : *In groups, collect pictures showing the various uses of electricity. Make a chart to outline these uses. Don't forget to mention what type of energy it is converted to in each case.*

8.2. Electric cell, circuit

ELECTRIC CURRENT

The flow of electrons in a conductor is called an electric current. Water flows between the two vessels A and B because of a 'difference in levels' of water in them (Fig. 8.1).

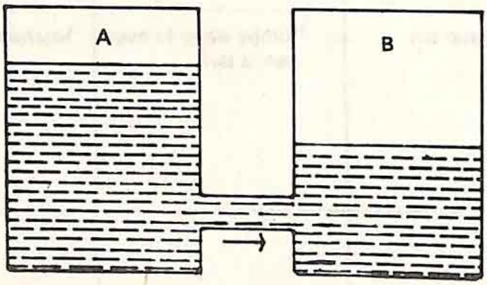


Fig. 8.1 Flow of water between two vessels

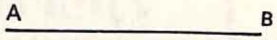


Fig. 8.2 Direction of flow of electric current

In the same way an electric current flows between two points of a conductor A and B due to a difference of potential between them, i.e., if electric current flows from A to B we say that A is at a higher potential than B (Fig. 8.2). One method of obtaining a potential difference so that electric current may flow is made use of in the 'cell'.

TORCH CELL

The simplest form of a cell is one in which two metallic plates are dipped in some chemical solution. By doing this a potential difference is developed between the two plates. In a torch cell it is not convenient to have a chemical solution and so the chemicals used are in the form of a paste. The two metals used, at the two ends are called the poles of the cell. The pole which is at a higher potential is called the positive pole and the pole which is at a lower potential is called the negative pole.

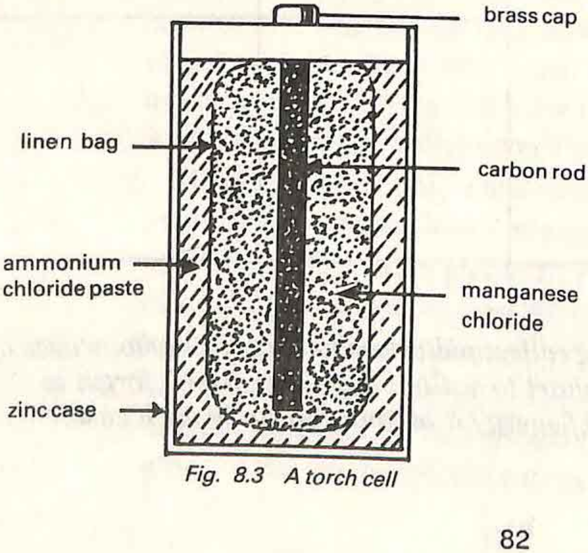
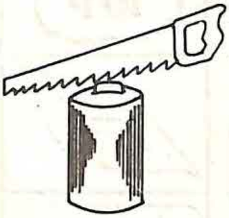


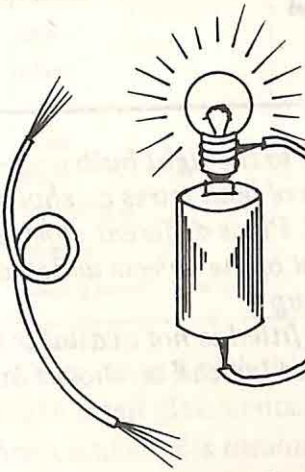
Fig. 8.3 A torch cell

CONSTRUCTION

The torch cell is really what is known as a dry Leclanche cell (Fig. 8.3). In this cell, the negative pole is a cylindrical vessel made of zinc and covered with cardboard. Inside this vessel is placed a linen bag, containing a carbon rod, which is the positive pole, surrounded by a paste of powered manganese dioxide and carbon. Around the linen bag is a paste of ammonium chloride called sal ammoniac and zinc chloride. The paste is held together by mixing it with flour, or gum and glycerine. The top of the zinc vessel is sealed with pitch. The potential difference between the two poles of the cell is 1.5 volts.



Activity 3 : *Using a saw or a sharp knife cut a torch cell vertically into half, just close to the centre terminal. You may need someone to help you to do this. Identify the different parts of the cell according to the figure.*

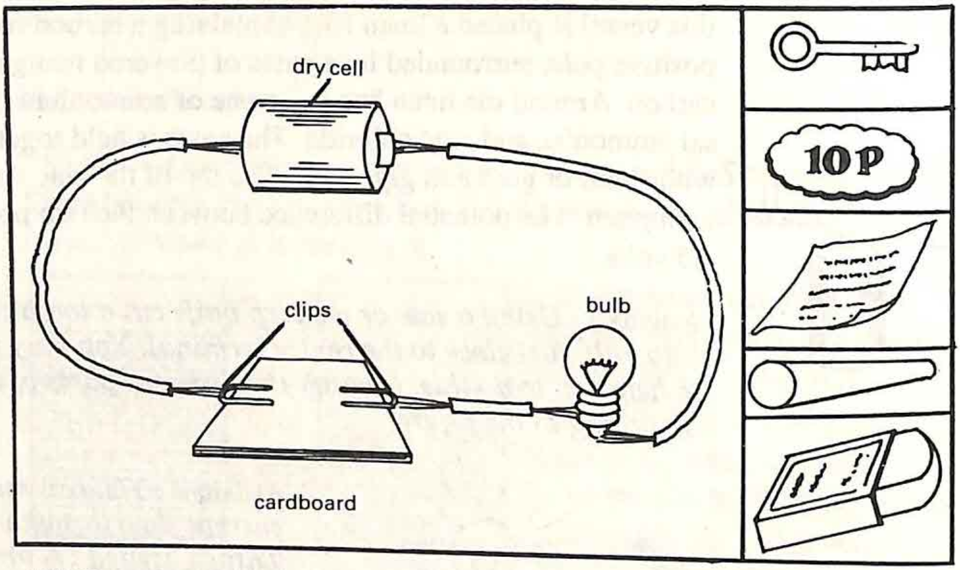


Activity 4 : *You can make electric current flow through a circuit.*
Things needed : A torch cell, a small bulb and socket and an insulated copper wire.
Cut the wire into small strips of about 20 - 25 cm in length. With a knife or blade remove the insulation (plastic covering or thread) from both ends. Wrap one end around the electric bulb and press it on to the centre terminal of the battery. Press the other end to the base of the battery. What do you see? Is electric current flowing through the bulb? If you don't press the wire to the base does current flow? What do you think is essential for current to flow?

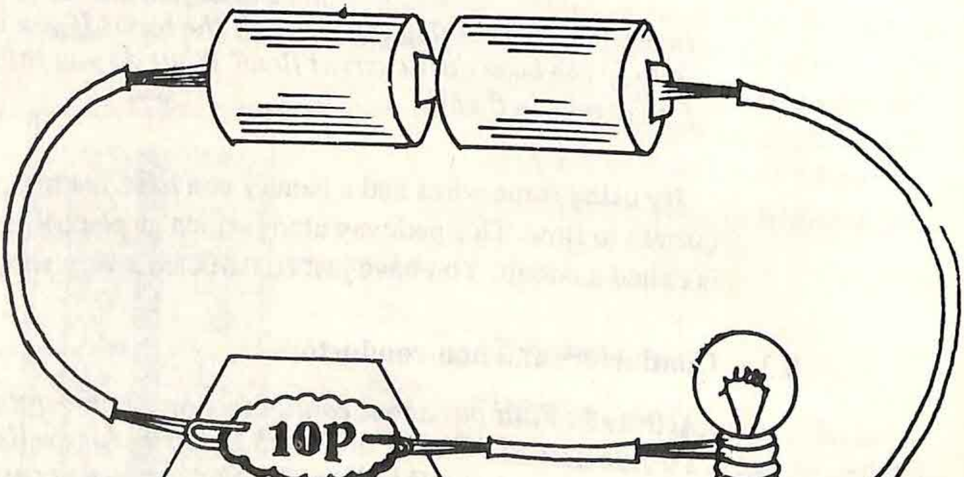
By using some wires and a battery you have made a path for electric current to flow. This pathway along which an electric current may flow is called a circuit. You have just constructed a very simple circuit.

8.3. Conductors and non-conductors.

Activity 5 : *Find out about conductors and non-conductors.*
Things needed : One or two torch batteries (dry cells), insulated copper wires, a small bulb and socket, a piece of cardboard rubber band, plastic band, coins (10p, 50p), a piece of cloth, wood, chalk and any other material of your choice.



Method : Connect a dry cell to the light bulb and socket. Attach paper clips to the bare ends of both wires as shown and fix the clips to pieces of cardboard. Place different objects so that they touch both clips. Make a list of the objects which close the circuit and cause the bulb to light up?
If a dry cell with terminals fitted is not available then you may use one or two torch batteries instead as shown in the following diagram.



With some materials you will find that the bulb glows. We call these materials *conductors* (substances which allow electric current to pass through them). With others it does not glow. We call these materials *non-conductors* (substances which do not allow electric current to pass through them).

Complete the tabular column given below based on Activity 5 :

Materials	*Does the bulb glow?*	*conductor of non-conductor?*
coin	yes	conductor
eraser		
paper		
nail		
chalk		
key		
salt solution		
vinegar		
baking powder solution		

You can test with the last three items by dipping the two paper clips into a small glass containing these liquids. Another name for a non-conductor is *insulator*.

8.4. Heating and lighting effect of current

In Activity 1, you have already listed the various uses of electricity and also the type of energy it is converted into. You will find that in many of the applications, the electrical energy is converted into either light energy or heat energy or both.

One such example is the electric bulb. The filament of the bulb becomes white hot due to the current flowing through it (Fig. 8.4).

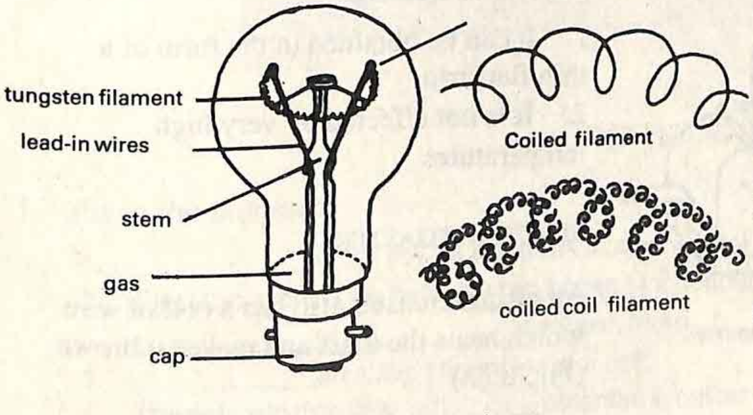


Fig. 8.4 An electric lamp

ELECTRICAL HEATING APPLIANCES

Electric cookers, toasters, irons, kettles, radiators, fires and stoves are appliances which depend on the heating effect of an electric current. All of these contain coils of wires called the *filament*, made of certain alloys which offer a high resistance to the passage of an electric current through them. Thus, when an electric current passes through them they become red-hot. In many of these appliances the insulators used are either porcelain or mica.

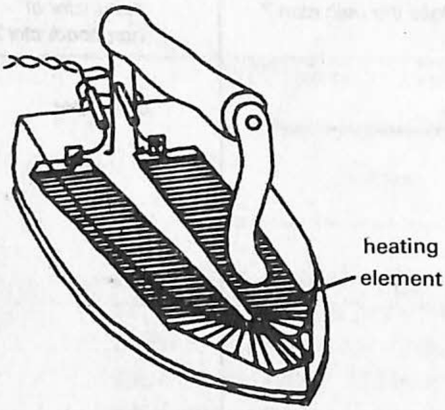


Fig. 8.5 An electric iron

ELECTRIC IRON

You have all seen and used an electric iron (Fig. 8.5). If you were able to take it apart you would see that it has a long flat strip of nichrome wire called the *heating element* wound around a thin flat sheet of mica. This is placed between two sheets of mica and placed on the bottom plate of the iron. The whole arrangement is covered with a metal covering fitted with an ebonite handle.

Nichrome is used for the heating element because,

1. It has a high melting point and so it can be heated to high temperatures.
2. It is possible to make very thin flat wires out of it.

Mica is used as an insulator because,

1. It can be obtained in the form of a thin flat strip.
2. It is not affected by very high temperatures.

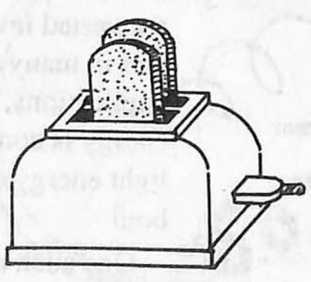


Fig. 8.6 a A toaster

ELECTRIC TOASTER

An electric toaster also has a coil of wire which heats the toast and makes it brown (Fig. 8.6a).

Other examples of electrical energy being converted to heat energy are the geyser (Fig. 8.6b), the hot plate (Fig. 8.6c), or the immersion rod (Fig. 8.6d). All of them use nichrome wire as the heating element. Which of these gadgets do you use in your homes?

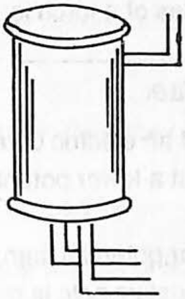


Fig. 8.6 b A geyser

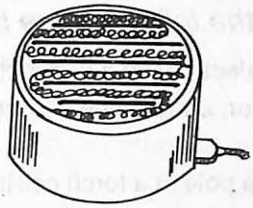


Fig. 8.6 c A hot plate

Fig. 8.6 d An immersion rod

Basic concepts

1. We use electricity in every sphere of our lives.
2. We cannot see electricity but we can see and feel the effect it produces.
3. Electric energy can be transformed into other types of energy.
4. An electric current can be obtained using a cell.
5. A torch cell is called a dry cell.
6. A pathway along which electric current may flow is called a circuit.
7. Substances which allow current to pass through them are good conductors.
8. Substances which prevent electricity from flowing through them are non-conductors or insulators.

REVISION TIME

I. *Fill in the blanks.*

1. ____________is the flow of electrons in a conductor.
2. Electric current flows between two points of a conductor due to a ____________of____________between them.
3. ____________are called the poles of a cell.
4. The pole which is at a__________potential is called the positive pole and the pole which is at a__________potential is called the negative pole.

5. The torch cell is known as the____________ cell.
6. The potential difference between the two poles of a torch is ____________volts.
7. The negative pole in a torch cell is made of____________

II. *State whether the following are true or false.*

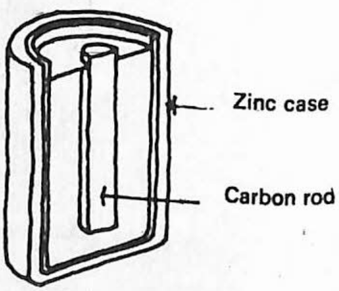
1. The flow of electrons in a conductor is called an electric current.
2. In a conductor, current flows from the point at a lower potential to the point at a higher potential.
3. The negative pole in a torch cell is at a higher potential than the positive pole.
4. The positive pole is made of zinc and the negative pole is made of carbon in a torch cell.

III. *Match the items in column A and B.*

A	B
i. Cylindrical zinc vessel	i. insulator
ii. Carbon rod	ii. electric lamp
iii. Nichrome	iii. alloy
iv. Mica	iv. positive pole
v. Tungsten filament	v. negative pole

IV. *Answer the following questions.*

1. What do you understand by an electric current?
2. How is electric current stored?
3. Why is air removed from an electric lamp?
4. What is an alloy?
5. What alloys are used to make filaments in electrical irons?
6. Is nichrome a metal or an alloy? Why? Why is it used?
7. What is mica? Where is it used?



IV. *Study at this diagram carefully.*

Now decide whether the following statements are true or false

a. The figure shows a dry cell in cross-section.
b. A dry cell is cylindrical in shape.
c. The paste of sal ammoniac and zinc chloride is placed in the centre of the cell.
d. The carbon rod is the positive pole.
e. The thin layer between the casing and paste is made of paper.
f. The cell is covered with absorbent paper.
g. The biggest part of the cell is filled with the electrolyte.
h. The potential difference between the two poles of the cell is 1.5 volts.

TEST PAPER — I
Chapter 1 to 3

Time : $1^{1}/4$ hrs.

I Tick the correct answer from the ones given below :

a. An overflow jar is used to

1. measure the volume of liquids.
2. measure the area of solids.
3. measure the volume of solids.

b. Work is done when

1. a force is exerted.
2. something moves.
3. a load is held on the head.

c. Thrust on a surface is

1. the pressure acting on it.
2. the normal force acting on it.
3. the pressure on unit area of it.

d. Pressure at a point in a liquid is

1. the same at all depths.
2. decreases with depth.
3. increases with depth.

II State whether the following statements are true or false :

a. Weight of a body can be found using a common balance.
b. In the first order lever the load and effort are on either side of the fulcrum.
c. Air is not felt because it does not have weight.
d. Liquid pressure at a given depth is the same in all directions.

III Fill in the blanks with suitable words.

1. The spirit level is used to find out if a surface is ________ .
2. Mecnanics is the study of bodies in ________ .
3. The unit of mass in the SI system is the ________ .
4. When one body moves over another ________ force acts.

IV *Match the following:*

1. volume
2. wound clock
3. density

a. kinetic energy
b. mass per unit volume
c. cubic centimetres
d. potential energy
e. metre squared

V *Answer any five of the following questions:*

1. How are the areas of regular shapes calculated? Give examples.
2. What are the different types of energy that you know of?
3. Why does wood float in water whereas metal objects sink in water?
4. Find the density of a sphere of mass 300gm and volume 50 cc.
5. Why is a dam broader at the base?
6. What would happen if there was no gravity?
7. What is the second order lever? Give examples.

VI *Answer any one of the following.*

1. How will you find the volume of a solid using an overflow jar and a measuring cylinder?
2. Write a few lines about the different types of forces you know.
3. Describe an experiment to show that air exerts pressure.

TEST PAPER — II
Chapters 1 to 8

Time $1^1/4$ hrs.

I. Tick the correct answers from the ones given below :

a. Density of a substance is

1. greater for heavier bodies.
2. is a constant for a substance.
3. increases with volume.

b. A good conductor of heat is

1. wood.
2. air.
3. cork.
4. copper.

c. A medium which allows light to pass through is

1. opaque.
2. transparent.
3. translucent.

d. A single fixed pulley is used to

1. increase speed.
2. decrease the load.
3. change the direction of the force.

II. State whether the following statements are true or false.

1. A pair of tongs is an example of a first order of lever.
2. Lodestone is an artificial magnet.
3. Sound travels faster than light.
4. All substances expand by the same amount.

III. Fill in the blanks with suitable words.

1. The mass of a body is the amount of ________ contained in it.
2. Water ________ its own level.

3. A liquid expands more than a _________ .
4. The negative pole of a torch is made of _________ .

IV. *Match the following :*

1. Nichrome
2. Tungsten filament
3. Spectrum

a. electric bulb
b. torch cell
c. magnet
d. alloy
e. dispersion.

V. *Answer any five questions from the following :*

1. How is a curved line measured by a thread?
2. Write a note on gravitational force.
3. What are the characteristics of liquid pressure?
4. Describe an experiment to show that solids expand when heated.
5. How can you show that light travels in straight lines?
6. Draw a torch cell and label the parts.
7. Draw four different types of magnets and label them.
8. Why is a gap left between rails.

VI. *Answer any one of the following :*

1. Draw diagrams to explain the formation of the umbra and penumbra in a shadow.
2. Describe how you would find out if the given materials are conductors of electricity or insulators.
3. Describe how you would construct your own spring balance.

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